BERICHTE

aus dem Fachbereich Geowissenschaften der Universität Bremen

No. 283

Hanebuth, T. J. J., W. Alekseev, A. Andrade Grande, B. Baasch, K.-H. Baumann, P. Behrens, V. B. Bender, T. von Dobeneck, A. I. dos S. Marques, T. Frederichs, J. Haberkorn, J. Hangen, C. Hilgenfeldt, J. Just, B. Kockisch, H. Lantzsch, A. Lenhart, A. Lipke, F. J. Lobo Sánchez, A. Mena Rodríguez, H. Müller, A. Petrovic, I. Rodríguez Germade, S. Roud, A. Schwab, T. Schwenk, I. Voigt, S. Wenau

REPORT AND PRELIMINARY RESULTS OF RV METEOR CRUISE M84/4 GALIOMAR III. Vigo – Vigo, 1st – 28th May, 2011.

Berichte, Fachbereich Geowissenschaften, Universität Bremen, No. 283, 139 pages, Bremen 2012

ISSN 0931-0800

The "Berichte aus dem Fachbereich Geowissenschaften" are produced at irregular intervals by the Department of Geosciences, Bremen University.

They serve for the publication of experimental works, Ph.D.-theses and scientific contributions made by members of the department.

Reports can be ordered from:

Monika Bachur

DFG-Forschungszentrum MARUM

Universität Bremen

Postfach 330 440

D 28334 BREMEN

Phone: (49) 421 218-65516

Fax: (49) 421 218-65515

e-mail: mbachur@marum.de

Citation:

Hanebuth, T. J. J. and cruise participants

Report and preliminary results of RV METEOR Cruise M84/4, GALIOMAR III, Vigo – Vigo, 1st – 28th May, 2011.

Berichte, Fachbereich Geowissenschaften, Universität Bremen, No. 283, 139 pages. Bremen, 2012.

ISSN 0931-0800

BERICHTE

aus dem Fachbereich Geowissenschaften der Universität Bremen

No. 283

Hanebuth, T. J. J., W. Alekseev, A. Andrade Grande, B. Baasch, K.-H. Baumann, P. Behrens, V. B. Bender, T. von Dobeneck, A. I. dos S. Marques, T. Frederichs, J. Haberkorn, J. Hangen, C. Hilgenfeldt, J. Just, B. Kockisch, H. Lantzsch, A. Lenhart, A. Lipke, F. J. Lobo Sánchez, A. Mena Rodríguez, H. Müller, A. Petrovic, I. Rodríguez Germade, S. Roud, A. Schwab, T. Schwenk, I. Voigt, S. Wenau

REPORT AND PRELIMINARY RESULTS OF RV METEOR CRUISE M84/4 GALIOMAR III. Vigo – Vigo, 1st – 28th May, 2011.

Berichte, Fachbereich Geowissenschaften, Universität Bremen, No. 283, 139 pages, Bremen 2012

ISSN 0931-0800

Table of Contents

1. Summary/Zusammenfassung 2

2. Participants 4

3. Research Programm 5

4. Narrative of the Cruise 6

5. Methods and Preliminary Results 9

5.1 Hydroacoustics 9
(T. Schwenk, A. Lenhart, J. Haberkern A. Petrovic, A. Schwab, S. Wenau, and all watch-keepers)
5.1.1 Multibeam bathymetric mapping 9
5.1.2 Sediment Echo Sounding (PARASOUND) 12

5.2 Multichannel Seismics 16
(T. Schwenk, A. Lenhart, J. Haberkern, A. Petrovic, A. Schwab, S. Wenau)

5.3 Electromagnetic Seafloor Profiling with ´MARUM-NERIDIS III´ 23
(H. Müller, T. von Dobeneck, C. Hilgenfeldt, B. Baasch, J. Just, S. Roud, A. Andrade Grande, I. Rodriguez Germade)

5.4 Physical Properties Studies 29
(T. Frederichs, V. Alekseev, A. Andrade, B. Baasch, V. Bender, K.-H. Baumann, P. Behrens, T. v. Dobeneck, I. Germade, J. Hangen, C. Hilgenfeldt, J. Just, B. Kockisch, H. Lantzsch, A. Lipke, F.J. Lobo Sanchez, A. Mena Rodriguez, H. Müller, A. Petrovic, S. Roud, A.-I. Santos, I. Vogt)

5.5 Sediment Surface Sampling and Shallow Coring 36
(V.B. Bender, A.I. dos S. Marques, I. Vogt)

5.6 Sediment Coring 42
(V.B. Bender, A.I. dos S. Marques, I. Vogt)
5.6.4 Detailed Core Descriptions and Physical Properties 49

5.7 Pore-Water Extraction 106
(A. Andrade Grande, I. Rodríguez Germade)

5.8 Acoustic Doppler Current Profiling (ADCP) 107
(H. Müller, B. Baasch, T. von Dobeneck, A. Andrade, I. Rodriguez Germade)

5.9 Water Sampling 107
(K.-H. Baumann)

6. Ship's Meteorological Station: Weather Conditions during M84/4 112
(Hartmut Sonnabend, Deutscher Wetterdienst)

7. Station List M84/4 115
7.1 List of Station Data 115
7.2 Documentation of Coring-Site Selection Strategy 119

8. Data and Sample Storage and Availability 139

9. Acknowledgements 139

1. Summary

The study of complex interactions governing sedimentary processes, transport routes and deposition dynamics at a continental margin are easier to understand where the system is simplified by the dominance of one external force. Off Northwest Spain, the sedimentary record on the Galician Shelf is controlled by a strong storm regime whilst contour-parallel currents seem to dominate at the continental slope.

Intention of this cruise M84/4 GALIOMAR III was to a) trace the modes and routes of sediment transport from shallow to deep waters, b) understand the role of the shelf break and back-cutting gully systems for the sediment export dynamics, c) analyze the different modes and pathways of material downslope processes, and d) use locally confined depocenters at the lower continental slope, inside the gullies as well as on the outer and middle shelf as archives for reconstructing modern and past environmental conditions. Research groups from Bremen (MARUM) and Spain/Portugal (Vigo, Granada, Lisbon) with strong seismic, sedimentological, magnetic, geochemical and palae-oceanographic expertise have participated in this cruise utilizing a large number of complementary research devices.

Extensive bathymetric mapping, PARASOUND and seismic profiling, during the first leg of this cruise, have shown how locally divers the sedimentary system in this study area is developed. On the slope, contouritic deposits seem to be the dominant feature indicating that current interactions with the morphology are omni-present. A surprising discovery along the margin is the manifold partitioning, with series of slope gullies, sporadic large canyon/channels systems draining deeply into the basin, and structural elements such as ridges and isolated mounts. Consequently, the sediment cores show a large variety of hemipelagic, contouritic, debritic and turbiditic successions.

During the second leg on the associated shelf, coast-parallel and coast-perpendicular profiles were recorded, using PARASOUND and the new electro-magnetic sled NERIDIS III, to map individual depocenters (e.g., mud belts, outer-shelf ridge fields, pathway depressions). Special focus, in combination with an extended sampling/coring program was given to the character of depositional boundaries and the stratigraphic history of depocenters.

The cruise M84/4 GALIOMAR III was, despite frequent rough weather conditions and heavy fishery activity, very successful. A complete bathymetry of the slope, 1500 km PARASOUND, 500 km seismic, and 130 km electromagnetic profiling, as well as coring (Rumohr, gravity, vibro) at not less than 108 stations were collected. With the analysis of this impressively large data set we expect to gain detailed insight into mechanisms and dynamics of sedimentary shelf-slope systems on different sub-modern to geological times scales.

Zusammenfassung

Das ansonsten sehr komplexe Wechselspiel von Sedimentationsprozessen mit Auswirkung auf Transportrouten und Ablagerungsdynamik ist an einem Kontinentalrand deutlich vereinfacht, an welchem eine externe Kraft dominiert. Die Sedimentationsbedingungen vor Nordwest-Spanien sind auf dem Schelf durch ein saisonales Sturmregime geprägt, während am Hang starke Ozean-strömungen dominieren.

Ziel der Forschungsfahrt M84/4 GALIOMAR III war es, a) die verschiedenen Modi und Routen des Sedimenttransports nachzuverfolgen, b) die Rolle von Schelfkante und rückwärtig einschneidenden gullies *für die Sedimenttransportdynamik zu verstehen, c) die verschiedenen Arten und Wege der hangabwärts gerichteten Prozesse zu analysieren und d) lokale Depozentren am Hangfuß, in den* gullies *sowie auf dem äußeren und mittleren Schelf zu nutzen, um die modernen und früheren Umweltbedingungen zu rekonstruieren. Arbeitsgruppen aus Bremen (MARUM) und Spanien/Portugal (Vigo, Granada, Lissabon), die eine große Expertise auf den Gebieten der Seismik, Sedimentologie, Umweltmagnetik, Geochemie und Paläozeanographie haben, nahmen zu diesem Zweck teil. Zudem haben wir eine größere Anzahl von sich ergänzenden Geräten eingesetzt.*

Eine ausgedehnte bathymetrische Kartierung und Profilierung mit Parasound und Tiefseismik während des ersten Fahrtabschnitt haben die stark Ausdifferenzierung des Sedimentationssystem im Arbeitsgebiet gezeigt. Am Hang ist die kontouritische Ausformung der Ablagerung Resultat der allseits vorherrschenden Hangströmungen. Überrascht hat uns, wie intensiv der Hang von gully-*Serien, weit ins Beckeninnere reichenden Canyon-Systemen sowie strukturellen Rippen- und* mount-*Strukturen geprägt ist. Die Sedimentkerne dokumentieren eine dementsprechend Bandbreite an hemipelagischen, kontouritischen, debritischen und turbiditischen Abfolgen.*

Während des zweiten Fahrtabschnittes haben wir senkrecht und parallel zur Küste lange Transekte mit PARASOUND sowie dem neuen elektromagnetischen Profiler NERIDIS III gefahren, um individuelle Depozentren (z.B. Schlammgürtel, Rippenfelder, Transportsenken) zu kartieren. Besonderes Augenmerk lag dabei auf der speziellen Beschaffenheit der Grenzen und der stratigraphischen Entwicklungsgeschichte dieser Ablagerungszentren. Hierzu haben wir die Profilierung mit einem intensiven Beprobungs- bzw. Kernprogramm ergänzt.

Die Forschungsfahrt M84/4 GALIOMAR III verlief überaus erfolgreich: wir haben eine vollständige bathymetrische Karte vom Kontinentalhang erstellt, Profile von 1500 km PARASOUND, 500 km Seismik und 130 km EM-Profiler eingefahren, sowie an nicht weniger als 108 Stationen Kerne gezogen. Die weitere Bearbeitung dieses Materials wird einen detaillierten Einblick in die Abläufe und Mechanismen eines Schelf/Hang-Systems auf den unterschiedlichen sub-modernen bis geologischen Zeitskalen erlauben.

2 Participants

Name	Given name	Duty on Board	Institution
Alekseev	Vasily	Deck technician	MARUM
Andrade Grande	Alba	Surface sampling	GEOMA
Baasch	Benjamin	Magnetics	GeoB
Baumann	Karl-Heinz	Water sampling	GeoB
Behrens	Philipp	Surface sampling	MARUM
Bender	Vera B.	Surface sampling	EUROPROX
Dobeneck	Tilo v.	Magnetics	GeoB
dos S. Marques	Ana Isabel	Surface sampling	CIIMAR/LNEG
Frederichs	Thomas	Magnetics	GeoB
Haberkorn	Julia	Seismics	GeoB
Hanebuth	Till	Cruise leader	MARUM
Hangen	Jannes	Deck technician	MARUM
Hilgenfeldt	Christian	Magnetics	GeoB
Just	Janna	Magnetics Mag-	EUROPROX
Kockisch	Brit	Lab technician	GeoB
Lantzsch	Hendrik	Geolab	GeoB
Lenhart	Antje	Seismics	MARUM
Lipke	Anna	Geolab	MARUM
Lobo Sánchez	Francisco	Geolab	IACT
Mena Rodríguez	Ángel	Geolab	XM-1
Müller	Hendrik	Magnetics	GeoB
Petrovic	Alexander	Geolab	MARUM
Rodríguez Germade	Isabel	Water sampling	GEOMA
Roud	Sophie	Magnetics	GeoB
Schwab	Arne	Seismics	MARUM
Schwenk	Tilmann	Leader seimics	GeoB
Voigt	Ines	Surface sampling	MARUM
Wenau	Stefan	Seismics	GeoB

Abbreviations:

MARUM	Center for Marine Environmental Sciences, University of Bremen, Germany
GeoB	Faculty of Geosciences, University of Bremen, Germany
EUROPROX	International Graduate College, Faculty of Geosciences, University of Bremen, Germany
IACT	CSIC-Instituto Andaluz de Ciencias de la Tierra, Granada, Spain
XM-1	Oceanografía xeolóxica e bioxeoquímica, Fac. de Ciencias del Mar, Univ. de Vigo, Spain
GEOMA	Group of Environmental and Marine Geology, University of Vigo, Spain
CIIMAR	Centro Interdisciplinar de Investigação Marinha e Ambiental, Porto, Portugal
LNEG	Laboratório Nacional de Energia e Geologia, Lisbon, Portugal

3 Research Program

The scientific targets of this leg with the acronym GALIOMAR III (*Galician Ocean Margin Expedition*) were 1) to identify characteristic structures and critical interfaces in sedimentary shelf systems and at the continental slope (as the final source of sediments) and 2) to use the associated deposits to reconstruct transport routes and sediment fluxes. In previous own studies (Pos-342, Pos-366/3), we have reconstructed the sedimentary history and the stratigraphic architecture of the Galician shelf in detail already. Further, we have roughly identified possible pathways of sediment export.

The following three hypotheses are, thus, the base for the project and this cruise M84/4:

a. Several individual transport pathways exist on the shelf but have been alternating active during the past 30 thousand years.

b. The sediment export across the shelf break and down the continental slope is controlled by the interplay of local morphological and (palaeo-) oceanographic elements.

c. Locally confined deposits at the foot of the continental slope (hemipelagic, contouritic, turbiditic) have formed in relation to the sediment pathways on the shelf and record the history of sediment export from the shelf in detail.

During the first leg of the cruise, we did extensive bathymetric mapping, run numerous seismic and acoustic profiles at the upper and lower continental slope accompanied by a number of sediment cores. Aim was to reconstruct the sediment export from the shelf into the deep sea during the late Quaternary times. The sediment-conducting structures (canyons, gullies) and confined depocentres (turbidite deposits, drift bodies) were in the main focus of this leg. The recovered sediment successions will be used as archives recording a) the variability of sediment availability from the shelf and b) the prevailing sediment transport modi alternatingly controlling deposition at the continental slope in high temporal resolution. We have fully realized our plan for this leg.

During the second leg of the cruise, we wanted to map sedimentary depocenters and their boundaries on the continental shelf, particularly depositional features which have formed by the local oceanographic regime (e.g., ripples fields, mud belts). Thus, extensive profiling with multibeam and PARASOUND and the EM-profiler lead to a great surface and subbottom data set. The program was completed by serial surface sampling as well as sediment coring along the main routes of sediment export. Special emphasis was also placed on the shelf break zone as a critical interface for sediment export. Despite heavy fishery activity and frequent rough weather conditions we were able to achieve our plans much to our satisfaction.

4 Narrative of the Cruise

The cruise M84/4 was organized in two legs with a 7-hours long technical stop in the harbor of Vigo in the middle of the cruise.

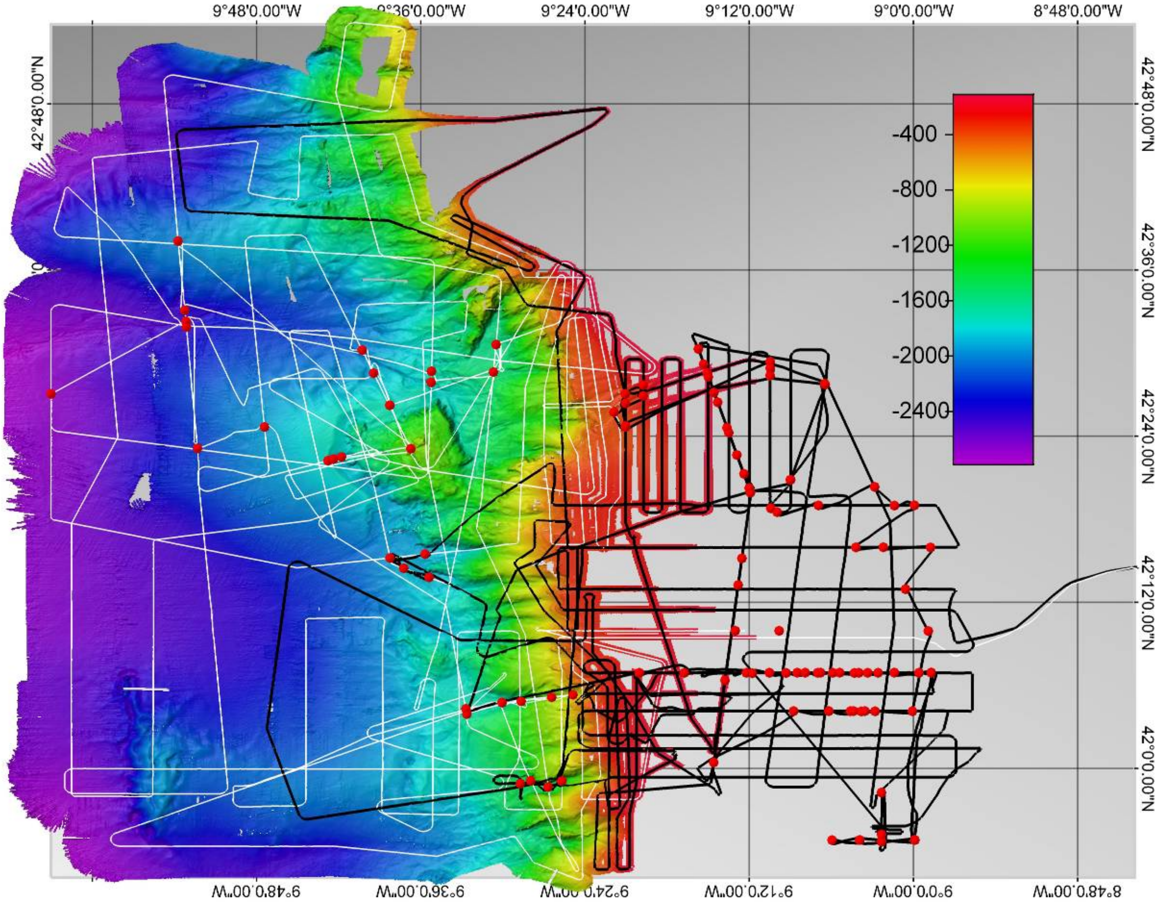


Fig. 4.1: Ship track of RV METEOR cruise M84/4 GALIOMAR III with seismic/echosounder profiles (1st leg white, 2nd leg black) and sediment sampling/coring stations (red dots).

During the *first leg*, we have worked in the area bound by the shelf break off Galicia in the East and the central part of the Interior Basin which is located between the continental slope and the eastern slope of the Galicia Bank (Fig. 4.1). Targets of the first leg were: a) The series of gullies and channels along the steep continental slope that cut back into the shelf break and might have served as sediment conduits in former times or have this function even still today. b) A large canyon-channel system on the continental margin off the Arousa region which is characterized by several generations of tributary channel systems as well as associated with numerous side terraces and mass movement bodies. c) Contouritic sediment bodies of which the largest and most conspicuous is surrounding a very prominent structural, to all sides sharp-bounded mount-like height. d) The hemipelagic sediment drape which covers most of the study area but with significantly varying sediment thicknesses which is obviously linked to the local ocean current patterns in interaction with a certain level of terrigenous sediment supply from the eastern side plus the local seafloor topography.

Our strategy was to map the seafloor bathymetry with the shipboard multibeam system around the elements of interest in best possible detail to obtain insight into the morphological organization of the area as well as create a basal map on which the further program of the leg could be organized. Due to frequently rough weather and sea conditions, which were frequently suppressing the deployment of other devices, and the limited dimensions of the study area we have mapped the area with an impressing complete coverage and in best lateral resolution. In a second step, we did sediment-acoustic (PARASOUND) and seismic (GI-GUN) measurements along numerous profiles across all the above mentioned structural and sedimentary elements. As well, we run several long profiles from the shelf break into the Interior Basin and in N/S direction. We are, thus, able now to interpret the origin of most of the morphological elements by their internal 3-dimensional architecture and their regional association with each other. To link acoustic facies with seafloor subbottom material and to understand sources and distribution patterns of sediments, we took series of multicores, giant box cores and gravity cores in a final step. The material obtained covers all sorts of slope and basin sediments, such as hemipelagic, contouritic, turbiditic sediment, slides, lag deposits and rocky relict surfaces. We had no problems to realize our program, aside from the fact that the weather and wave conditions become generally rougher with distance to the coast.

The detailed narrative of the first leg was as follows:

Date	**Activity, research program**
May 29	Official reception on board of R/V METEOR at 5 p.m.
May 30	Configuration of seismic and coring devices/setting the labs
June 01	Leave port of Vigo/ PARASOUND profiling at the southern continental slope
June 02	Box cores along one of the slope gullies/first seismic profiling
June 03	Seismic profiling of two long N/S overview transects
June 04	Surface sampling and coring at the middle continental slope
June 05	Surface sampling and coring of contourite and main canyon-channel
June 06	Seismic profiling of W/E transects from basin to shelf break
June 07	Surface sampling and coring of the hemipelagic basin
June 08	PARASOUND and multibeam along the shelf break
June 09	Seismic profiling of the continental slope and in the basin
June 10	Surface sampling and coring at contourite and basin stations
June 11	Surface sampling and coring at basin and slope stations
June 12	Surface sampling and coring in a second slope gully
June 13	Enter port of Vigo at 9 a.m./disembark seismic equipment

At the end of this leg, we had a short stop in the harbor of Vigo. We have used this time to disembark the compressor container and the seismic winch, reorganize the containers on the after deck and to configure the electro-magnetic profiling sledge. Also, a limited staff exchange was carried out.

During the <u>*second leg*</u> of cruise M4/4, we have focused our activity on the continental shelf off Galicia (Fig. 4.1). Targets of the part of the cruise were: a) The boundaries and transient sedimentary facies changes from inner to outer shelf and parallel to the shelf break which should reflect the position of important sediment export pathways as well as sediment sorting and distribution patterns. b) The mid-shelf mud belt which's thickness and distribution patterns we have mapped with PARASOUND in good spatial resolution to obtain a data base for sediment budget calculations. c) Local fields of seafloor irregularities which might be related to wave-like deposits superimposing the undulating underlying rock substratum. d) The linkage of the sedimentary shelf system with the gullies on the uppermost slope to understand the role of the shelf break in sediment behavior.

The detailed narrative of the second leg was as follows:

Date	**Activity, research program**
June 13	Reorganize the after deck/limited staff exchange/leave port at 4 p.m./mapping survey along the first EM track
June 14	Surface sampling and coring in a third slope gully
June 15	Surface sampling and coring in the southern mud belt area around a wreck to obtain trawling-undisturbed sediments
June 16	First EM profile off Vigo from shelf break to inner shelf/afterwards mapping survey along new potential EM tracks
June 17	Second EM profile off Vigo from shelf break to inner shelf/afterwards mapping survey along new potential EM tracks
June 18	Third EM profile off Vigo/collision with fisher net, complicated rescue action of the sledge/surface sampling during night time along the first EM profile
June 19	Surface sampling and coring in the southern mud belt area/surface sampling along the second EM profile/PARASOUND mapping of gully heads during night time
June 20	Surface sampling and coring in one of the southern slope gullies (see June 02)
June 21	EM profiling stopped due to technical problems/surface sampling and coring of undulating deposits ("waves") off the Arousa area
June 22	Fourth EM profile from S to N parallel to the shelf break
June 23	EM profiling finished due to technical problems/24 hours surface sampling along the PARASOUND profiles
June 24	Surface sampling and coring of confined depocenter off the Arousa area
June 25	Surface sampling and coring of different sedimentary units off the Arousa area/loss of vibro corer/6 hours of unsuccessful rescue action/surface sampling along the fourth EM profile
June 26	ADCP profiles in W/E directions, very rough sea
June 27	Second 5-hours lasting attempt to retrieve the vibro corer/PARASOUND profiling off the Arousa area
June 28	Enter port of Vigo at 09 a.m./disembark all five containers/end of cruise

Since we wanted to deploy the new electro-magnetic profiling sledge, we first have run long E/W profiles with the shipboard multibeam and PARASOUND systems to be sure that no obstacle (such as wrecks, outcropping rocks etc.) might be barrier for the ground-towed profiler device. In a second step, we have deployed this sledge along these mapped corridors measuring even subtle lithological and physical variations in outstanding lateral resolution. However, the frequently rough sea conditions, numerous wrecks (or things of similar size and shape), and an enormous fishery activity had strong influence on the sledge program continuously causing great time delays and forcing us to slalom courses. In the final step, we have taken series (1-2 nautical miles distance) of short gravity cores (Rumohr corer) which will enable us to calibrate the physical/magnetic data of the sledge with real sedimentological/geochemical data. Beside this electromagnetic program, we have mapped the above mentioned sedimentary and erosive structures with PARASOUND to get an idea about the geometries reflecting the formation processes. Sediment coring with the vibrocorer which is able to drill into coarse-grained, carbonaceous, dry and even lithified materials. The sedimentary facies recovered by these cores are as manifold as one should expect from such a shelf environment and reflect the original and individual formation processes of each of the investigated elements and bodies. Unfortunately, the vibrocorer got lost at the end of the leg in 110 m water depth; two 6-hours lasting endeavors to retrieve this device again were without success.

5 Methods and Preliminary Results

5.1 Hydroacoustics

(T. Schwenk, A. Lenhart, J. Haberkern A. Petrovic, A. Schwab, S. Wenau, and all watch-keepers)

During RV METEOR Cruise M84-4 three hull-mounted echosounder systems were used, namely the Kongsberg Simrad EM 710 for bathymetric mapping in shallow water depths, the Kongsberg Simrad EM 122 for bathymetric mapping in middle and deep water depths and the sediment echo sounder system PARASOUND DS-3/P70 (Atlas Hydrographic) for imaging the sediment column. All systems were used in a 24 hour watch mode.

5.1.1 Multibeam Bathymetry Mapping

5.1.1.1 Technical Description

The EM122 system allows an accurate bathymetric mapping down to full ocean depth. Basic components of the system are two linear transducer arrays in a Mills Cross configuration with separate units for transmitting and receiving. The nominal sonar frequency is 12 kHz with an angular coverage sector of up to 150° and 432 soundings per swath. The emission cone is 150° wide across track, and 1° in along track direction. The reception is obtained from 288 beams, with widths of 2° across track and 20° along track. Thus, the actual footprint of each beam has a dimension of 1° by 2°. The achievable swath width on a flat bottom will usually be up to 6 times the water depth dependent on the roughness of the seafloor. The angular coverage sector and beam pointing angles may be set to vary automatically with depth according to achievable coverage. Using the high-density mode, which creates 432 soundings out of the 288 beams, and the dual swath mode (2 swaths per ping), finally 864 isolated equidistant depth values are obtained perpendicular to the track for each ping. Using the detected two-way travel time and the beam angle known for each beam, and taking into account the ray bending due to refraction in the water column due to sound speed variations, depth is calculated for each beam. A combination of amplitude (central beams) and phase (slant beams) is used to provide a measurement accuracy practically independent of the beam pointing angle. Besides the depth values the EM122 provides also backscatter information and pseudo-sidescan images.

The EM710 multibeam echo sounder is a high to very high resolution seabed mapping system. The minimum acquisition depth is from less than 3 m below its transducers, and the maximum acquisition depth is specified down to 2000 m. However, during previous cruises it turned out that the quality of the data degrades in water depths deeper than 600 m. During this cruise we realized that during heavy weather conditions the useful depth range is limited to 400 m. The across track coverage (swath width) can reach 5.5 times the water depth. The EM710 operates at sonar frequencies in the 70 to 100 kHz range. The transmit fan is divided into three sectors to maximize range capability but also to suppress interference from multiples of strong bottom echoes. The sectors are transmitted sequentially within each ping, and uses distinct frequencies or waveforms. The along track beam width of the system installed on RV METEOR is 1 degree. A ping rate of up to 25 per second is possible. The transmit fan is electronically stabilized for roll, pitch and yaw. The EM710 has a reception beam width of 1 degree as well. The number of beams is 256 or 400 (high resolution mode). The beam spacing may be set to equiangular or equidistant. The received beams are electronically roll stabilized. A combination of phase and amplitude bottom detection algorithms is used in order to provide soundings with the best possible accuracy. Additionally, an integrated seabed acoustical imaging capability is included as standard. A real time display window for water column backscatter is also available.

Both systems worked reliable during the whole cruise. However, both systems have problems with rough weather conditions: The outer beams of EM122 get wobbling in depth deeper than 2000 m, the EM 710 lost the bottom in depths deeper than 400 m.

5.1.1.2 Processing of the Data

Processing and imaging of the data was done partly on board. For quick overview maps, the raw data from both multibeam systems were loaded into the Fledermaus Professional Suite (7.2) for gridding and display. Later, the EM122 data were processed using the CUBE algorithm und the

3-D Editor, both implemented in Fledermaus Professional Suite (7.2). First sidescan images were also produced using the GeoCoder of Fledermaus Professional Suite (7.2).

5.1.1.3 Preliminary Results

The collected EM122 bathymetry gives a first overview about all morphological structures in the study area from the shelf break down to the Galicia Basin (Fig. 5.1). In general, the morphology of this part of the Iberian Margin reveals a complex pattern probably driven by the interaction of down-slope and along-slope sedimentation processes as well as tectonic influences. The latter ones are expressed in two ridges, one stretching from West to East in the northern part of the study area, and one stretching from North to South in the southwestern part of the study area. Another probably tectonic feature is a distinct seamount with rather steep flanks in the centre of the study area. The top of the seamount is nearly 1000 m high above the surrounding. The continental slope is dissected by several gullies, which differ significantly in sizes and shapes. These gullies imply that downslope processes play a major role in shaping this margin. Most of the gullies terminate in depth of 1600 – 2000 m, and only two submarine channels can be identified in deeper parts.

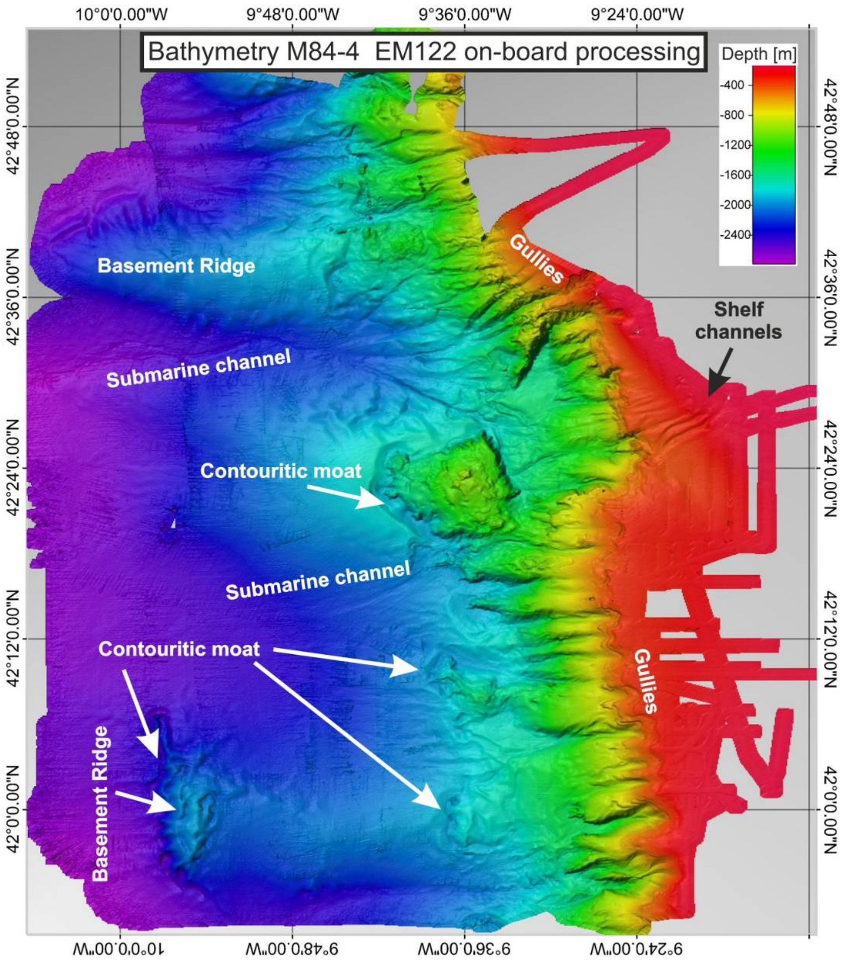


Fig. 5.1: Bathymetric map of the study area

The northern submarine channel is fed by several gullies. Some of them are connected to shelf channels which cross the shelf break. The impact of bottom currents on the morphology is manifested by several contouritic features. Contouritic moats are found on the western flank of the seamount and of the north-south stretching ridge, but also close to some smaller elevations on the lower slope. All the moats are located in depths between 1600 and 2400 m, indicating that they were build up under the influence of the northward flowing North Atlantic Deep Water. Western of the moats drift-like morphologies can be identified with the typical drift crests, however, if these structures really represent contouritic drifts has to be evaluated with the multichannel seismic data.

5.1.2 Sediment Echo Sounding (PARASOUND)

5.1.2.1 Technical Description

Since March 2006 the new PARASOUND system P70 is installed on RV METEOR. The system uses the parametric effect, which occurs when very high (finite) amplitude sound waves are generated. If two waves of similar frequencies are generated simultaneously, also the sum and the difference of the two primary frequencies are emitted. For the PARASOUND System, 18 kHz is one fixed primary frequency, which distributes energy within a beam of 4.5° for a transducer of ~1 m length. The second primary frequency can be varied between 18.5 and 24 kHz, resulting in difference frequencies from 0.5 to 6.0 kHz. This signal travels within the narrow 18 kHz beam, which is much narrower than e.g. a 4 kHz signal, emitted from the same transducer directly (30°). Therefore, a higher lateral resolution can be achieved, and imaging of small scale structures on the sea floor is superior to conventional systems. As another consequence, the signal bandwidth is also increased, and much shorter signals can be generated with improved vertical resolution. However, due to the very narrow beam, it is necessary to control beam direction to compensate the ship's movement and to send the energy vertically downwards. The system treats three signals separately: the primary high frequency signal (18 kHz; PHF), the secondary low frequency signal (selectable 0.5 to 6.0 kHz; SLF) and the secondary high frequency (selectable 36.5 to 42 kHz; SHF). All three signals are recorded separately. Alternatively, also exclusively a low frequency signal (PLF; 3 or 12 kHz) can be emitted at much lower energy levels, where sound emission energy levels have to be limited (e.g. for mammal protection).

The system sediment response is recorded before the next pulse is sent, which is necessary when imaging of the water column should be done (single pulse mode). To enhance horizontal resolution, the pulse train mode and the quasi-equidistant mode is also available. To adapt the ping rate of all modes the automatic depth detection by using the PHF is used. The PARASOUND system uses minimum three different computer systems. Two of them control real time signal generation and data acquisition through a Linux and a Windows XP system. The third PC is available for the operator. This Operator-PC hosts the Hydromap Database Server, the Hydromap Control Software and the ParaStore 3 Software. The Hydromap Control Software is responsible for all systems setting and for communication with the real time computer.

During the entire cruise M84-4, the PHF frequency of 18 kHz was acquired. The SLF frequency was set to 4 kHz during acquisition on the continental slope during the first leg. On the shelf it turned out the 3 kHz is the best compromise between penetration and resolution. The system was nearly always used in the single pulse mode to conduct water column imaging.

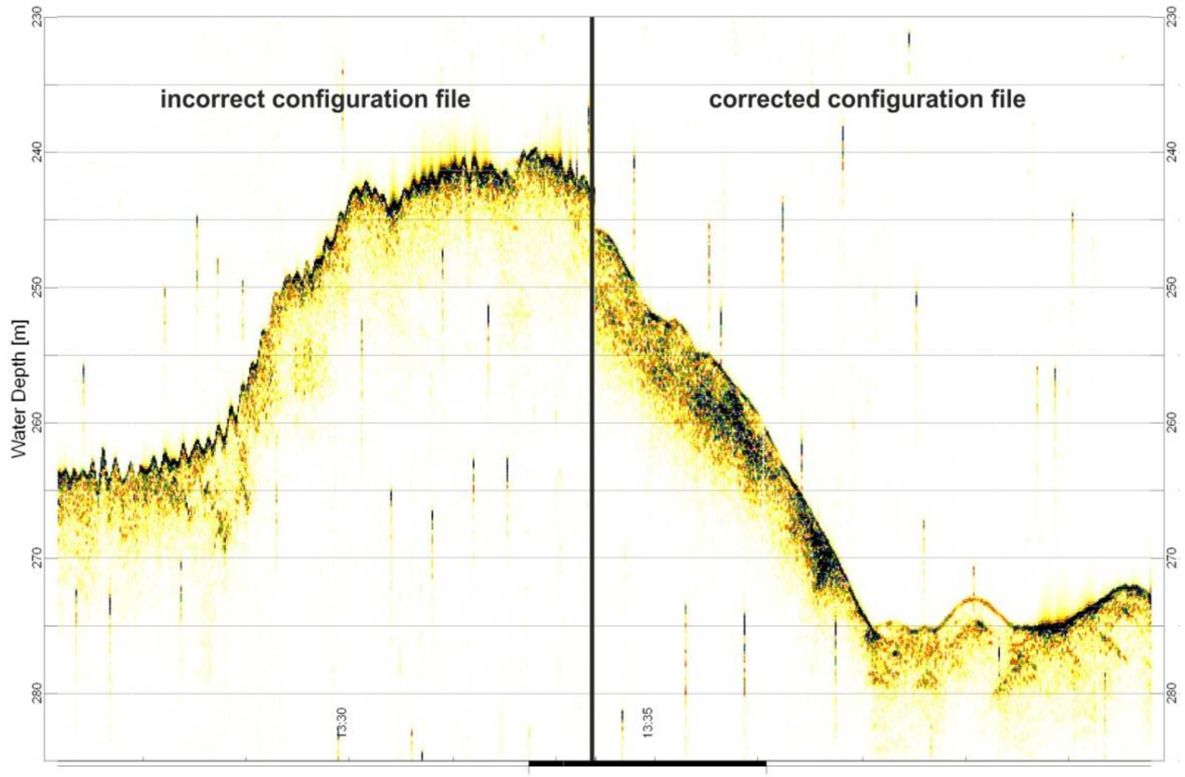


Fig. 5.2: Comparison of PARASOUND data before and after correction of the lever arms in the configuration file at the 18.05.2011.

Especially on the shelf during rough weather conditions it was realized during the second leg, that the data were obviously not fully motion corrected. After several days of remote maintenances by Atlas Hydrographic, it turned out that the values for the distance between motion sensor and transducer were wrongly set in the configuration file. This value, the lever arm for the pitch, has been changed during the last shipyard stay, but was not changed in the configuration file. After changing this value, the data quality improved significantly. Using the correction also in "Advanced Option Panel" in Parastore, replays of data from the slope show much better coherence and penetration. Therefore all data from the cruise up the correction of the configuration file at the 18.05.2011 has to be replayed. Figure 5.2 shows the PARASOUND data before and after correction of the configuration file at the 18.05.2011.

5.1.2.2 Processing of the Data

For visualization, online processing and storage, the ParaStore Software Package was used. Data can be stored in the PARASOUND own ASD format, but also in the more common PS3 or SEG-Y Format. Several windows can be opened to display different signals (PHF, SLF, SHF) with different scaling and/or processing parameters. This allows optimizing windows for specific purposes, as e.g. imaging of the upper 20 m of sediments to select optimal coring locations, to choose a full penetration plot, which also allows coverage of the topography, or to study the complete water column. For quick images of the sediment column, the custom made software SeNT was used. Furthermore, the SLF data (4 kHz) were processed using the custom made software ps32sgy, including re-sampling of the data to reduce data size while maintaining high resolution, and frequency filtering to separate noise from the source signal. The resulting sgy-data were loaded into Kingdom Suite (SEG-Y format) for a first spatial interpretation and for planning of coring stations.

5.1.2.3 Preliminary Results

As preliminary results three PARASOUND examples are presented here, one from the shelf, one from the shelf break, and one from the deeper part of the study area. Figure 5.3 presents a typical profile crossing the central shelf from west to east. Clearly visible is the most recent depocenter on the shelf. This so-called Mud Belt is here characterized by a max. thickness of ~5 m and onlaps on older sediments which are represented by a mix of prolonged and transparent layers. Seawards of the mud belt the PARASOUND data reveals a high reflectivity seafloor and weak signals from the sediments below, which indicates coarse grained material at the surface. However, it is visible that layers beneath the surface are dipped and show a toplap at the seafloor indicating that these layers represent a regressive system tract.

The PARASOUND profile shown in Figure 5.4 crosses from South to North three channels close to the shelf break in water depths around 300 m (see also Fig. 5.1). The channels are characterized by reliefs of 20 m and widths of around 500 m, and are located on the northern flank of a depression. South of the channels this depression is filled by a complex pattern of sedimentary structures. On top of well stratified layers, parallel to subparallel reflectors are intercalated by transparent units, probably representing slides. All these layers are partly heavily folded and interrupted by cut and fill structures indicating that a mix of different processes produced this depression filling. South of the depression the acoustic facies changes drastically to a prolonged seafloor with a high reflectivity and less signal penetration. Beneath the seafloor, inclined sediment units can be identified.

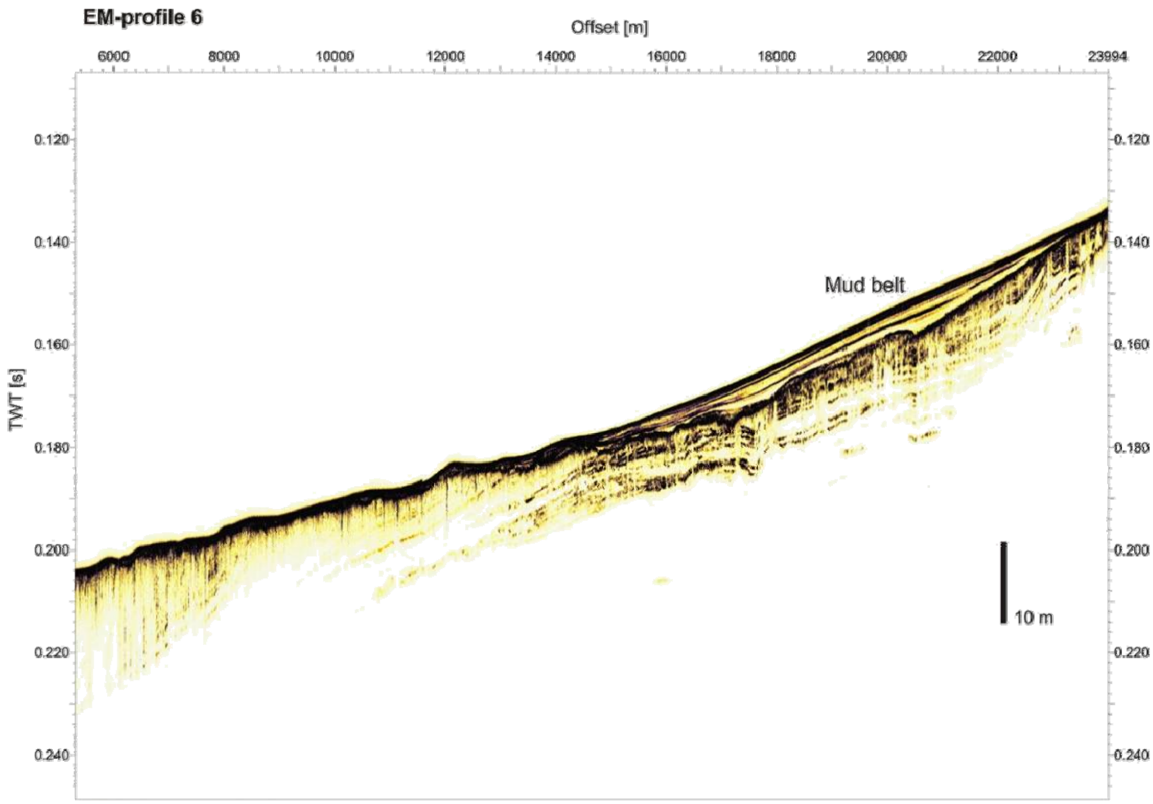


Fig.5.3: PARASOUND profile crossing the mud belt on the central shelf.

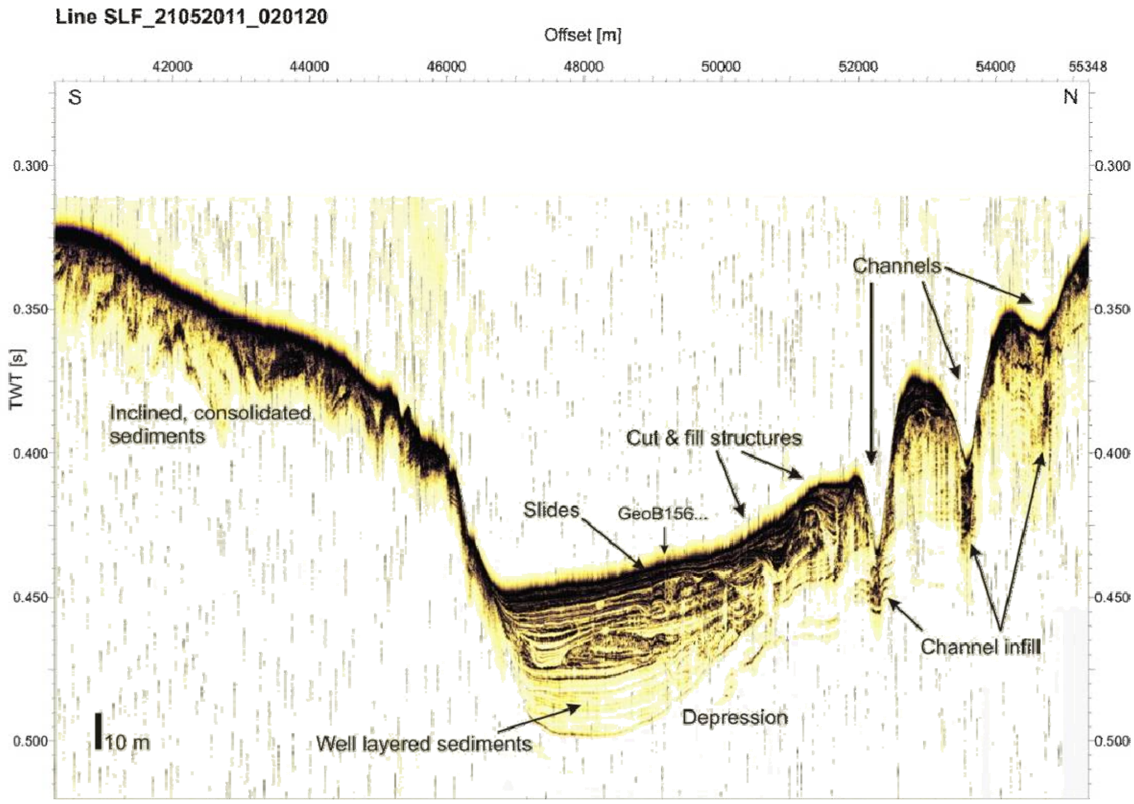


Fig. 5.4: PARASOUND profile parallel to the shelf break.

The last PARASOUND example (Fig. 5.5) shows the sedimentary structures around the northern submarine channel in water depths around 2350 m, collected during Seismic Profile GeoB11-010. The submarine channel is located in a broader valley, and the flanks of this valley are characterized by different acoustic facies. On the flank north of the channel, the data reveal prolonged but subparallel reflectors with less penetration of the signal. Both observations indicate a bottom current controlled sedimentation of coarse grained sediments. Closer to the channel, transparent bodies are visible, suggesting mass flow deposits there. The channel itself is characterized by asymmetric flanks and a sedimentary filling of ~20 m. However, the upper flanks of the channel show erosional truncation, therefore a recent activity of the channel is not unlikely. South of the channel, the sediment column is represented by wavy, parallel to subparallel reflectors, partly intercalated by thin transparent layers. The signal penetration is much deeper here as north of the channel. All observations imply, that sedimentation on the flank south of the channel is as well mainly contouritic, but gravity-driven down slope processes have also an influence on the sedimentary architecture.

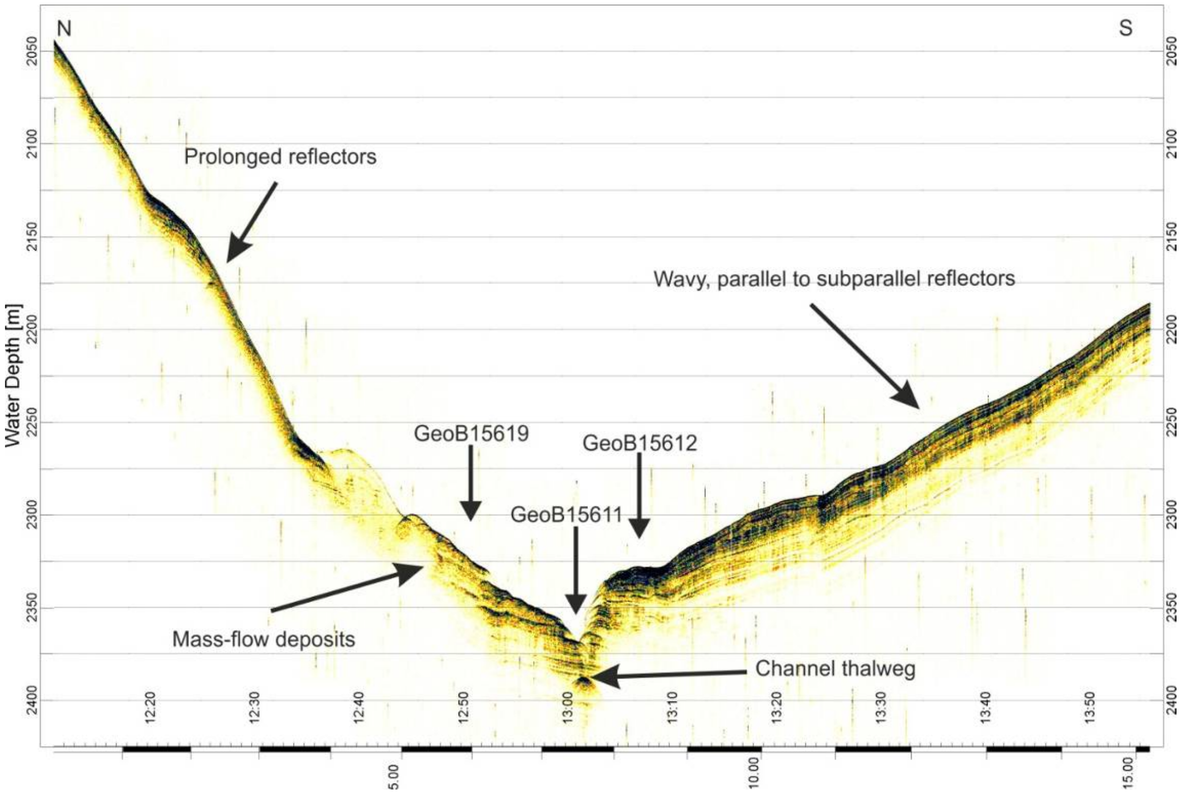


Fig. 5.5: PARASOUND data from Profile GeoB11-010 imaging the northern submarine channel.

5.2 Multichannel Seismics

(T. Schwenk, A. Lenhart, J. Haberkern, A. Petrovic, A. Schwab, S. Wenau)

During the cruise M84/4 the equipment of the working group Marine Technology/Environmental Research at the Department of Geosciences, University of Bremen, was used for acquiring high-resolution multichannel seismic data to image the sedimentary structures on a meter-scale, which can usually not be resolved by conventional seismic systems. Main components of the system are the seismic source, the streamer, the acquisition system, the trigger unit and the GPS/Navigation system from the ship (Fig. 5.6)

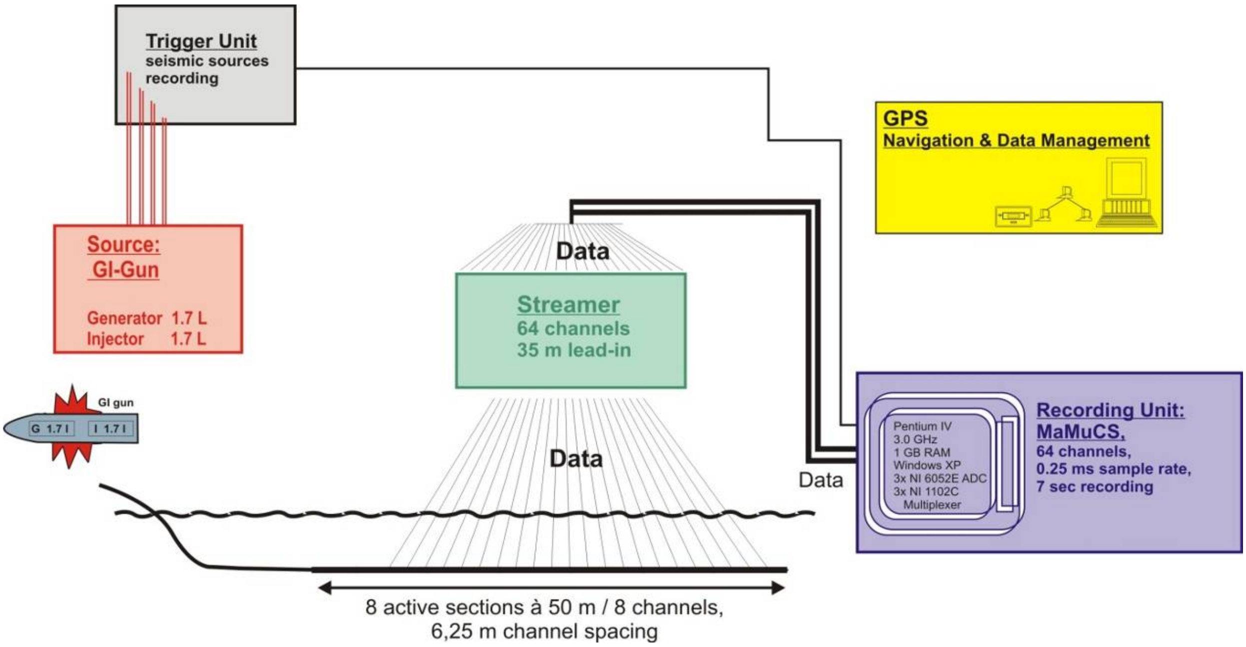


Fig. 5.6: Seismic system setup during cruise M84-4a

5.2.1 Technical Description

5.2.1.1 Source and Receiver

As seismic source a GI-Gun (generator volume: 1.7 L, injector volume: 1.7 L) was shot on all seismic lines. The main frequency range of the emitted sound waves is 100-300 Hz. The gun was towed at the port side ~16 m behind the ship's stern (Fig. 5.7). The gun was shot in a harmonic mode. The injector was triggered with a delay of 25 ms to the generator signal which basically eliminated the bubble signal. High-pressurized air was provided by the new compressor container manufactured by Sauer Company normally used on RV MERIAN. The gun was shot at an air pressure of 145-155 bar. The shooting rate was 7 seconds. Average speed during seismic profiling was ~5 kn resulting in a shot point distance of appx. 10 m. Compressor and gun worked quite reliable, therefore no data gap exists.

Data were received by a 400 m long 64-channel analogue streamer (SYNTRON) of Bremen University with up to 13 hydrophones per group. The streamer consists of 8 active sections of 50 m length, which are subdivided into 8 hydrophone groups. Each of the 6.25 m long hydrophone groups is again subdivided into 5 subgroups of different length. A programming module distributes the subgroups of 4 hydrophone groups, i.e. a total of 20 groups, to 4 channels. To keep the streamer in a constant depth, five Digi Birds were attached. Bird depths were set before each survey through the Digi Bird Controller. This PC should also have monitored and recorded bird depths and magnetic orientation, however, due to serious connection- and trigger-problems this functionality was switched off. The active section was towed with a Lead-In and a Stretch. The length of the Lead-In behind the ship was 35 m, the length of the Stretch was 48 m, adding to 83 m distance between the start of the active section and the ships stern (Fig. 5.7).

5.2.1.2 Data Acquisition

Data were recorded with the custom designed MaMuCS-System (Marine Multi Channel Seismic Acquisition System), which was developed at Bremen University. It consists of a Pentium IV based PC (3 GHz, 1GB RAM, Windows XP) with three NI6052E 16bit AD-converters. Each ADC is connected to a 32 channel multiplexer (NI-SCXI1102-C) with onboard preamplification and anti-alias filter. The system therefore provides a maximum of 96 channels at maximum sampling rate of 10 kHz per channel. The sample rate can be increased dynamically if the number of channels is reduced.

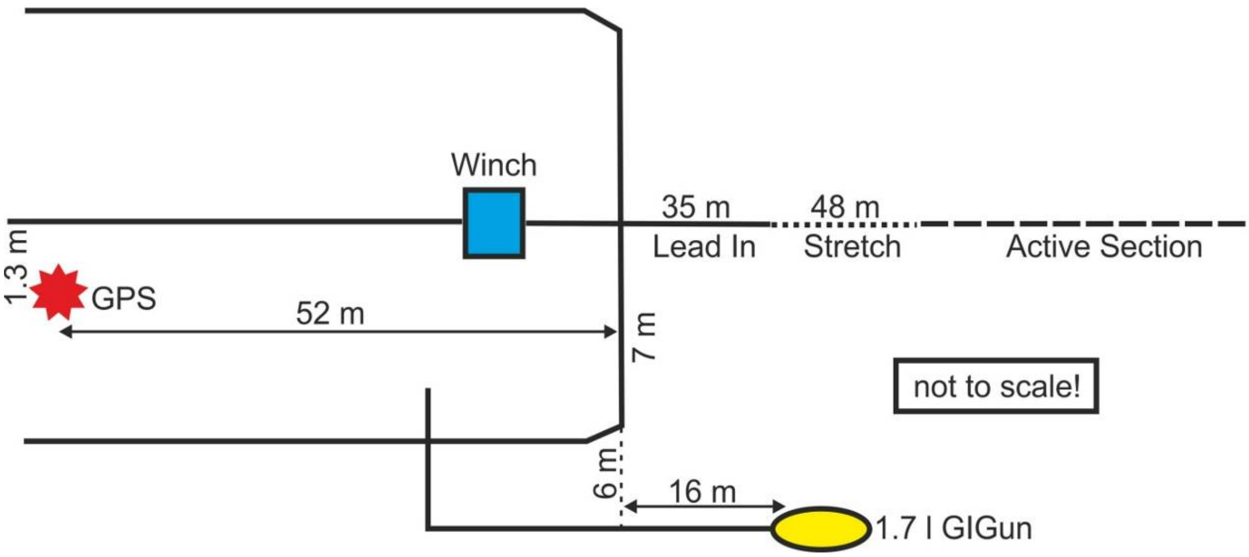


Fig. 5.7: Towing geometry during cruise M84-4a

The acquisition software provides nearly continuous recording of the 96 channels with data storage in demultiplexed SEG-Y format (floating-point IEEE) to hard disk. The software allows online quality control by displaying shot gathers and an online profile plot using brute stacks of arbitrary channels. The online profile can additionally be printed immediately to an attached windows printer and/or stored in SEG-Y format. The MaMuCS-PC is also used for logging the ship's GPS data and also for distribution the GPS data to other PCs via the network.

5.2.1.3 Trigger Unit

The custom trigger unit that was used during the cruise controls the seismic source, the MaMuCS system and the DiGi-Bird controller. The unit is set up on an IBM compatible PC with a Windows NT 4.0 operating system and includes a real-time controller interface card (SORCUS) with 16I/O channels, synchronized by an internal clock. The unit is connected to an amplifier unit and a gun amplifier unit. The PC runs custom software, which allows defining arbitrary combinations of trigger signals, which are used to optimize the available recording time for the seismic source and to minimize shot distance. Trigger times can be changed at any time during the survey. Through this feature, the recording delay can be adjusted to water depth without interruption of data acquisition. The amplifier unit converts the controller output to positive TTL levels. The gun amplifier unit, which generates a 60V/ 8A trigger level, controls the magnetic valve of the gun.

5.2.2 Preliminary Results

During cruise M84/4, seismic data were collected on 42 profiles with a total length of ~ 800 km. For profile list, see Appendix. One main focus was to image sedimentary structures around the submarine channel and its tributary gullies in the northern half of the study area (Fig. 5.8).

Profile GeoB11-021 (Fig. 5.9) was shot perpendicular to the slope nearly parallel to the channel and reveals the slope architecture in this area with respect to the distance to the shelf break. Clearly visible is the acoustic basement with a ~ 500 m sediment package on top. The basement crops out on the upper slope and defines thereby sedimentary sub-basins. Downslope of the outcrop chaotic deposits are visible, followed by a section characterized by more stratified sediments. The lower slope of the profile is again dominated by chaotic deposits, which suggests that mass transport deposits play (not surprisingly) a major role in the depositional history here. In the central part the profile cut the levee deposits south of the channel (Figs. 5.8 and 5.9).

Profile GeoB11-012 (Fig. 5.10) crosses the submarine channel from North to South parallel to the slope (see Fig. 5.8). A thick acoustic basement is recognizable in the centre of the profile beneath the recent channel. The basement dips up beneath the ridge north of the channel, suggesting that this ridge has a tectonic evolution. In contrast, the acoustic basement beneath the elevation south of the channel is horizontal, which indicates that this elevation is a positive sedimentary structure. The sediment column can be vertically separated into an upper package of high amplitude reflectors on top of a package of low amplitude reflectors. This change in seismic facies indicates a higher sedimentation dynamic during the deposition of the upper unit. All reflector packages reveal a subparallel pattern, probably causes by the interaction of bottom currents and sedimentation, but also creeping of the sediments is possible, especially on the ridge north of the channel.

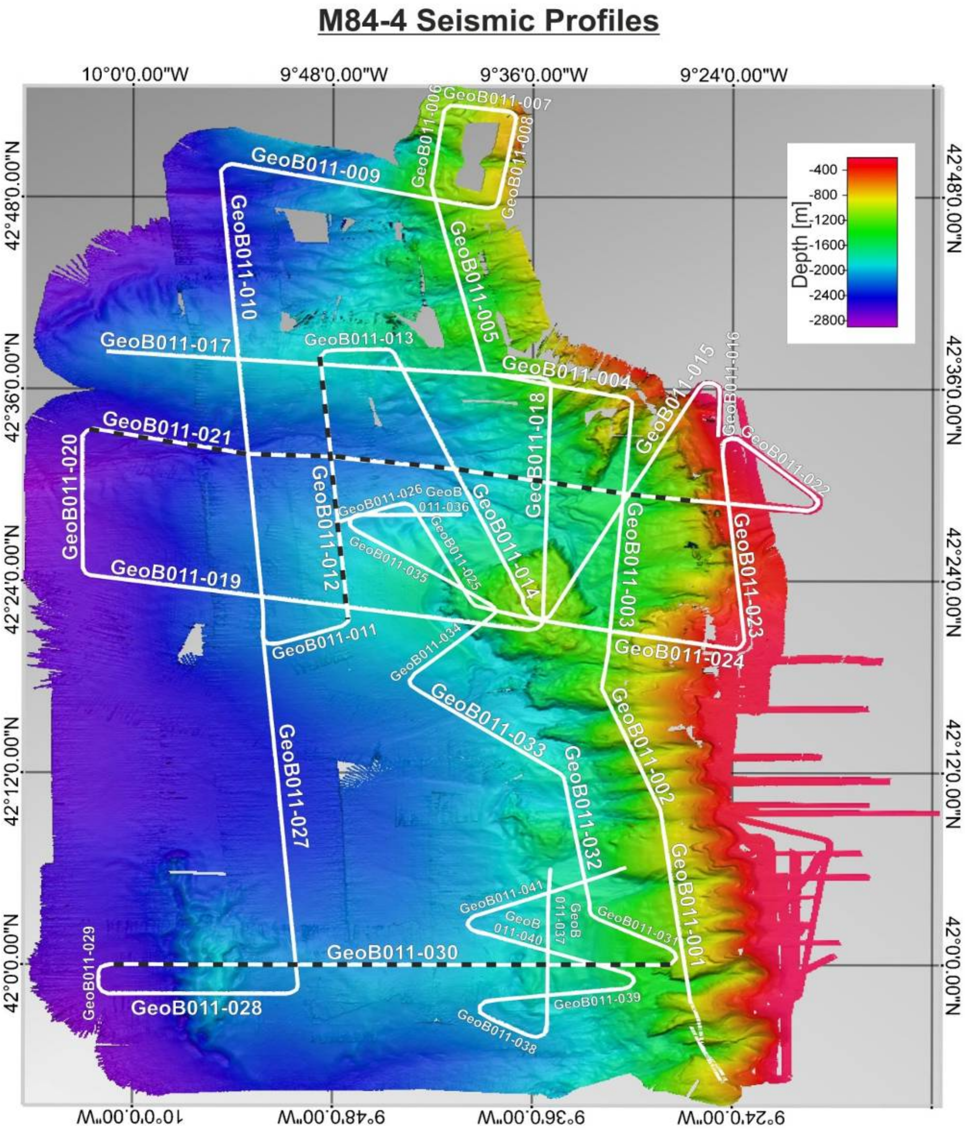


Fig. 5.8: Map of seismic profiles on top of multibeam bathymetry. Black-white dashed lines reprents profiles shown in the cruise report.

Profile GeoB11-030 (Fig. 5.11) runs perpendicular to the slope and is located in the southern part of the study area (see Fig. 5.8). It crosses the north-south trending ridge located there, which is characterized by an upcoming basement revealing the tectonic origin of this feature. In between the ridge and the upper slope a sediment filled basin is visible. As in Profile GeoB11-012, a vertically separation of high- and low-amplitude reflectors can be recognized. It is also obvious, that the level of the seafloor east of the ridge is higher as west of the ridge, suggesting that the ridge acts as obstacle for downslope transported sediments. On the slope, several small contouritic drifts were identified, demonstrating the impact of bottom currents on the shape of the margin.

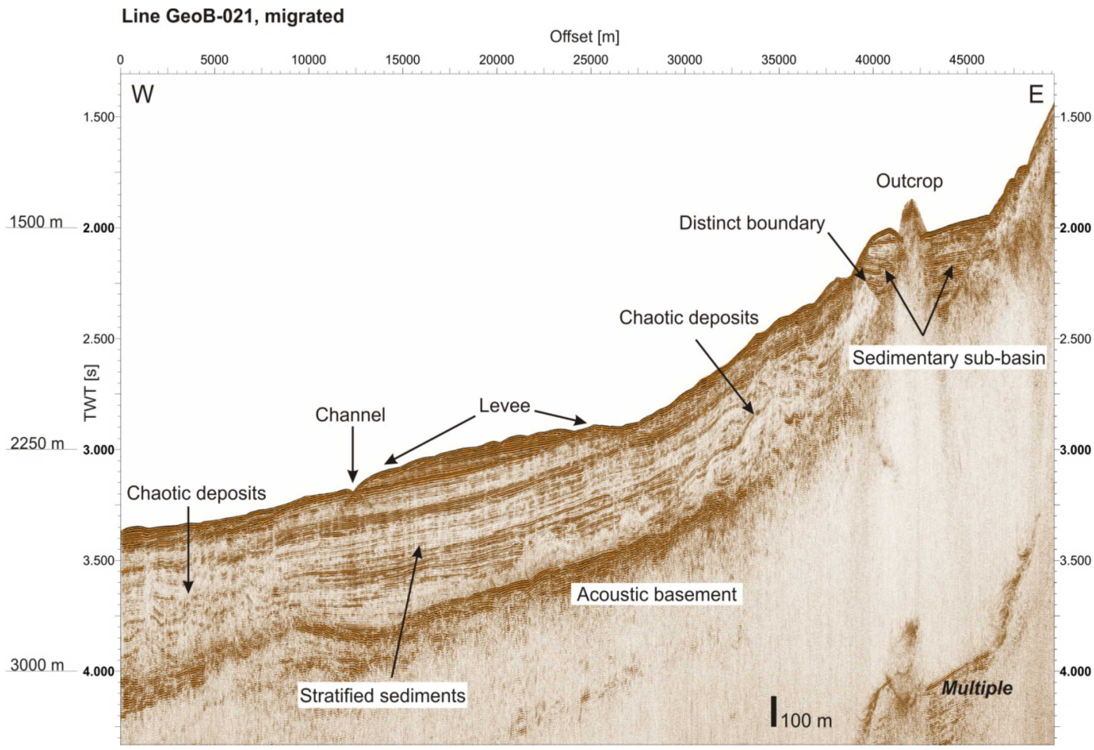


Fig. 5.9: Seismic Profile GeoB11-021 running parallel to the submarine channel in the northern part of the study area. For location, refer to Figure 5.8.

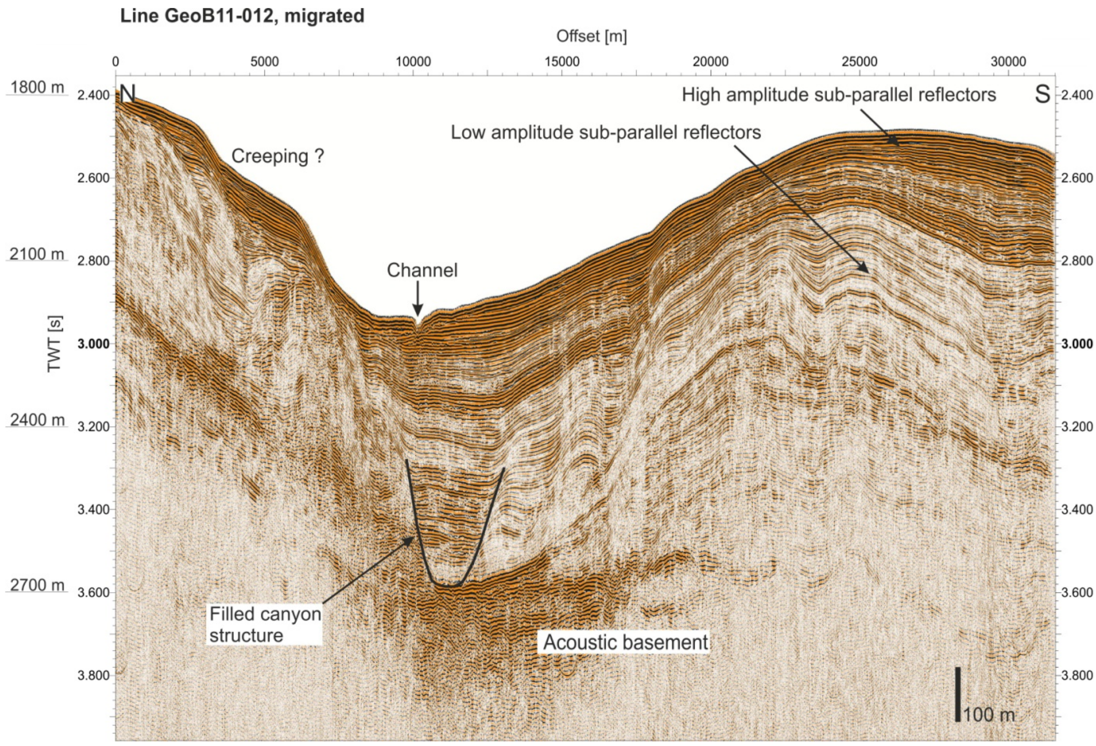


Figure 5.10: Seismic Profile GeoB11-012 crossing the submarine channel in the northern part of the study area. For location, refer to Figure 5.8.

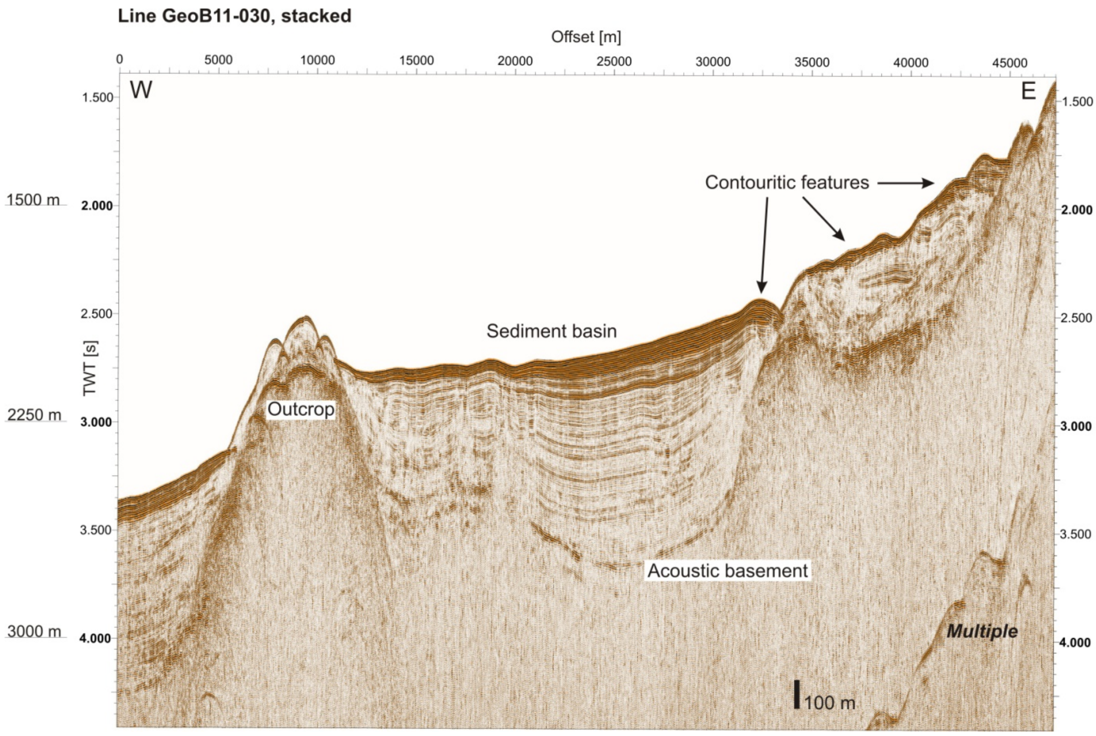


Fig. 5.11: Seismic Profile Geob11-030 showing the sedmentary basin between the basement ridge and the slope in the southern part of the study area. For location, refer to Figure 5.8.

Table 1: List of seismic profiles.

	Start					End				
Number of profile M84-4-GeoB11-	Date	Time UTC	Latitude south xx° xx.x‘	Longitude east xx° xx.x‘	MaMuCS FFN	Date	Time UTC	Latitude south xx° xx.x‘	Longitude east xx° xx.x‘	MaMuCS FFN
001	2.5.11	17:01	41°58.26	-9°26.56	437	2.5.11	19:06	42°9.83	-9°28.37	1605
002	2.5.11	19:17	42°9.91	-9°28.40	1606	2.5.11	20:43	42°17.09	-9°31.73	2339
003	2.5.11	20:43	42°17.09	-9°31.73	2339	3.5.11	00:19	42°34.842	-9°30.051	4273
004	3.5.11	00:30	42°35.519	-9°30.667	4339	3.5.11	1:40	42°36.865	-9°38.168	4949
005	3.5.11	1:52	42°37.413	-9°39.012	5036	3.5.11	04:08	42°48.82	- 9°42.08	6209
006	3.5.11	04:09	42°48.82	- 9°42.08	6213	3.5.11	05:04	42°53.496	- 9°41.262	6686
007	3.5.11	05:11	42°53.721	- 9°40.544	6746	3.5.11	05:35	42°53.339	- 9°37.377	7011
008	3.5.11	05:47	42°52.792	- 9°37.018	7084	3.5.11	06:55	42°47.615	- 9°38.139	7649
009	3.5.11	07:05	42°47.339	- 9°38.975	7728	3.5.11	09:25	42°50.043	- 9°54.179	8915
010	3.5.11	09:35	42°49,376	-9°54,716	8997	3.5.11	15:37	42°20.349	-9°52.142	12035
011	3.5.11	15:46	42°20.060	-9°51.292	12117	3.5.11	16:24	42°21.225	- 9°47.303	12431
012	3.5.11	16:30	42°21.702	- 9°47.034	12486	3.5.11	19:57	42°38.102	- 9°48.681	14222
013	3.5.11	20:04	42°38.422	- 9°48.044	14283	3.5.11	20:35	42°38.473	- 9°44.686	14545
014	3.5.11	20:41	42°38.152	- 9°44.244	14595	4.5.11	00:36	42°21.777	-9°35.934	16657
015	4.5.11	00:47	42°22.036	-9°34.805	16666	4.5.11	03:51	42°36.064	-9°26.071	18242
016	4.5.11	04:09	42°35.851	- 9°24.773	18395	4.5.11	04:45	42°33.002	- 9°24.874	18701
017	6.5.11	00:27	42°38.348	- 10°1.810	183	6.5.11	04:18	42°36. 656	- 9°35.180	2160
018	6.5.11	04:25	42°36.259	- 9 °34.917	2211	6.5.11	08:01	42°21.024	- 9°35.800	3546
019	6.5.11	08:06	42°20.979	- 9°36.296	3585	6.5.11	11:52	42°24.432	- 10°2.767	5505
020	6.5.11	11:59	42°25.031	- 10°3.003	5564	6.5.11	13:31	42°33.180	- 10°2.940	6365
021	6.5.11	13:39	42°33.473	- 10°2.206	6423	6.5.11	19:57	42°28.801	-9°19.214	9667
022	6.5.11	20:09	42°29.337	-9°19.122	9768	6.5.11	21:04	42°32.933	-9°23.786	314
023	6.5.11	21:16	42°32.382	-9°24.658	412	6.5.11	23:38	42°20.088	-9°23.359	1627
024	6.5.11	23:46	42°19.813	-9°24.120	1695	7.5.11	02:12	42°22.587	-9°39.592	2939
025	7.5.11	02:15	42°22.820	-9°39.733	2964	7.5.11	02:33	MaMuCS crash		
025b	7.5.11	02:55	start			7.5.11	03:30	42°28.736	-9°43.340	291
026	7.5.11	03:36	42°28.814	-9°44.025	354	7.5.11	04:17	42°27.494	-9°48.278	703
027	9.5.11	07:19	42°20.944	-9°52.208	237	9.5.11	11:21	41°58.462	-9°50.142	2272
028	9.5.11	11:28	41°58.199	-9°50.828	2333	9.5.11	12:58	41°58.357	-10°1.840	3048
029	9.5.11	13:03	41°58.774	- 10°2.008	3139	9.5.11	13:19	41°59.997	- 10°1.327	3266
030	9.5.11	13:22	41°59.997	- 10°1.002	3290	9.5.11	18:31	42°0.122	-9° 25.578	5897
031	9.5.11	18:44	42° 1.052	-9°27.833	6010	9.5.11	19:25	42°3.024	9°32.333	6350
032	9.5.11	19:29	42°3.429	-9°32.550	6393	9.5.11	20:56	42°11.569	-9°34.061	7118
033	9.5.11	21:02	42°12.007	-9°34.461	7173	9.5.11	22:43	42°18.011	-9°43.271	8026
034	9.5.11	22:45	42°18.208	-9°43.986	8049	9.5.11	23:45	42°22.035	-9°38.245	8551
035	9.5.11	23:52	42°22.581	-9°38.588	8613	10.5.11	01:26			9404
036	10.5.11	01:41	42°28.140	-9°45.858	8	10.5.11	02:31	42°28.144	-9°40.072	432
037	12.5.11	01:20	42°6.064	-9°34.877	124	12.5.11	03:12	42°55.773	- 9°35.172	1088
038	12.5.11	03:20	45°55.528	-9°36.031	1156	12.5.11	03:48	41°57.025	-9°39.057	1395
039	12.5.11	03:59	41°57.782	- 9°38.444	1487	12.5.11	05:04	41°58.598	-9°30.220	2046
040	12.5.11	05:14	41°58.418	-9°30.119	2132	12.5.11	06:30	42 2.217	-9 39.637	2784
041	12.5.11	06:40	42 3.082	-9 39.372	2871	12.5.11	07:45	42 5.808	-9 31.112	3422

5.3 Electromagnetic Seafloor Profiling with ´MARUM-NERIDIS III´

(H. Müller, T. von Dobeneck, C. Hilgenfeldt, B. Baasch, J. Just, S. Roud, A. Andrade Grande, I. Rodriguez Germade)

5.3.1 Technical Description

The novel MARUM-NERIDIS III (NERItic DIScoverer) is a bottom towed, marine electromagnetic (EM) profiler (Fig. 5.12, left) that quantifies both, the magnetic susceptibility and the electric conductivity of shallow marine deposits. The two physical properties differ fundamentally insofar as susceptibility assesses sediment matrix properties such as terrigenous or iron mineral content, redox state and contamination level, while conductivity primarily relates to the fluid-filled pore space and detects salinity, porosity and grain-size variations.

Fig. 5.12: (left) NERIDIS III during recovery; (center) control center; (right) safety buoy.

The EM profiler (Fig. 5.13) was equipped with an EM induction sensor, a conductivity-temperature-depth (CTD) probe with turbidity meter, two pressure housings containing control units (PC, motion sensor, network and telemetry components) and lithium batteries and an emergency flotation device that allows the recovery of the profiler from the sea surface after loss of the tow connection. A safety buoy with Xenon light and radio beacon (Fig. 5.12, right) was attached to the profiler by means of a 500 m Kevlar rope.

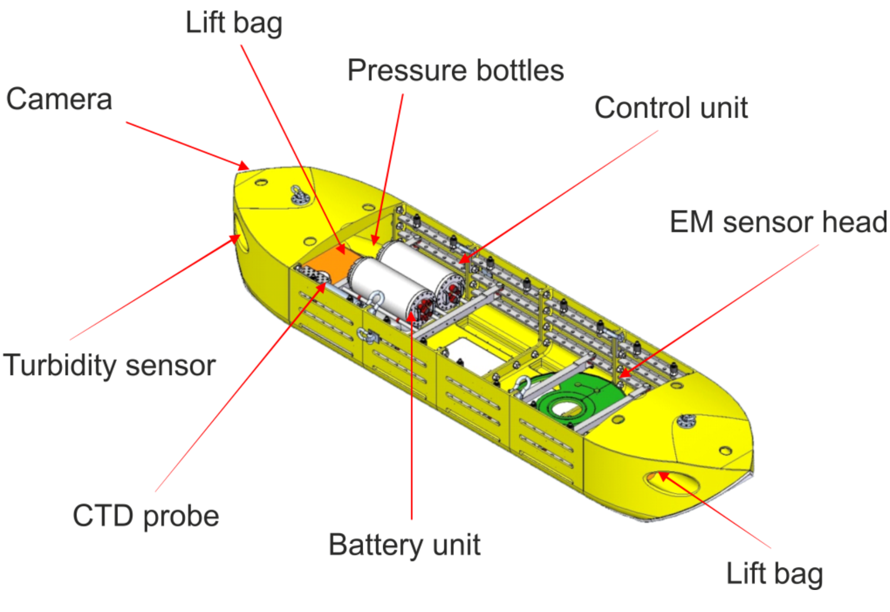


Figure 5.13: Setup of the MARUM NERIDIS III EM profiler (frame: non-magnetic, non-conductive, ruggedized fiberglass sled; dimensions: 5.2 x 1.2 x 0.6 m).

Deployment and recovery of the system was realized via the A-frame off the stern of R/V METEOR, making use of winch W3 with 11 mm armored coax cable (Fig. 5.14). EM, CTD, navigation and winch data were controlled in real time in the Lab 9 (“Mess- und Registrierlabor”;

Fig. 5.12, center). EM 710 Multibeam and PARASOUND data were gathered along the EM tracks before each EM profile was conducted and during the deployment of the profiler to avoid collisions with obstacles or fisher nets.

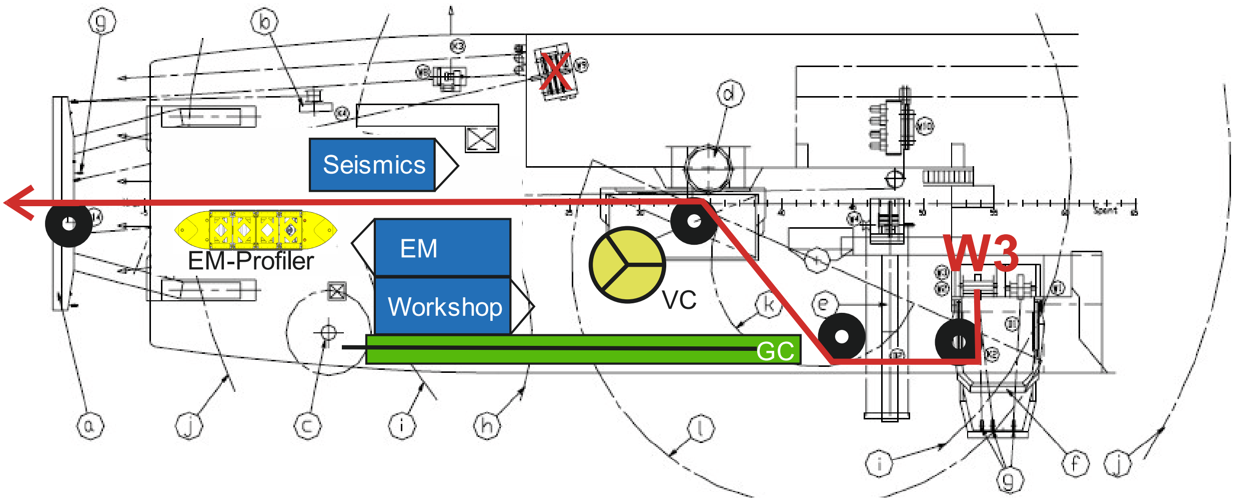


Fig. 5.14: Schematic view of the quarterdeck configuration showing the projected tow cable pathway (red), the EM profiler (yellow), container (blue) and coring devices.

Ground distance and operation frequencies of the broadband frequency-domain controlled source EM sensor of horizontal coplanar and concentric coil configuration were optimized for synchronous magnetic susceptibility and electric conductivity measurement of surficial sediment (90% signal from 0-50 cm subbottom depth). Operation frequencies of 75, 175, 525, 1025 and 2725 Hz were used with peak transmitter moment of 174 Am². Lateral sub-meter resolution of the magnetic susceptibility and electric conductivity of the seafloor was reached at sampling rates of 25 samples per second. 4 Hz conductivity, temperature and pressure data of the CTD were used to calculate bottom water salinity and to establish a sub-meter resolution along-track bathymetry. The newly implemented turbidity sensor produced very useful and relevant information on nepheloid sediment transport.

MARUM NERIDIS III is the successor of NERIDIS II that was successfully used over a total of 300 km profile length the Galician shelf during R/V POSEIDON cruise P366/3 in 2008 and lost by unfortunate maneuvers during R/V METEOR cruise M78/3 in 2009. The new, technologically far advanced EM profiler was tested in February 2011 on R/V ALKOR and performed its first scientific mission during this cruise. NERIDIS III comprises a number of novel safety concepts like an autonomous flotation device. Handling of the profiler improved significantly by using the W3 winch instead of the W12 friction winch used in 2009. Pre-surveying with the EM 710 multibeam sonar and PARASOUND echosounder was performed in advance of all NERIDIS III operations to identify and avoid obstacles on the seafloor.

R/V METEOR had to stop or abort profiles severally due to closely crossing fisher boats (although local fishermen were informed by local radio about all deployments of this deep-towed system), numerous ships wrecks as well as the frequent appearance of gillnets and floating nets. On May 18th, tow-line and sled collided with a fisher net trawled right across R/V METEOR's track causing a critical situation for the EM profiler and ship. Thanks to excellent work of our crew, the profiler was successful recovered without visible damage, but malfunction of an irreplaceable flotation device valve manifested after the collision. After a thorough risk evaluation with the ship's command, it was decided to withdraw from any further deep-towed operations due to unacceptably high risks of further collisions with omnipresent and often hidden fishing gear in this probably most intensely fished area of Europe.

5.3.2 Data Acquisition

The MARUM-NERIDIS III was deployed along 3 E-W profiles, and 1 S-N profile on the Galician continental shelf (Table 2). Sensor calibration in the water column was performed in a deep-sea setting, where the system was lowered stepwise down to 400 m water depth. At typical tow speeds between 2-4 knots, a total profile coverage of 118 km was achieved in water depths between 100 and 200 m. All parts and operations of the EM Profiler worked reliably and produced excellent data.

Table 2: EM Profiles on the continental shelf.

Profile	Start		End		Length
EM001	42° 07' 00" N	009° 16' 59" W	42° 07' 00" N	008° 58' 39" W	26.99 km
EM002	42° 04' 33" N	009° 18' 49" W	42° 04' 16" N	008° 58' 19" W	28.63 km
EM003	42° 01' 24" N	009° 21' 56" W	42° 01' 10" N	009° 17' 33" W	6.34 km
EM004	42° 00' 00" N	009° 14' 40" W	42° 30' 00" N	009° 15' 37" W	56.32 km

5.3.3 Preliminary Results

EM profiling in this area had the objective to classify the facies and textures of the surficial sediments and to map their distribution at meter-scale spatial resolution with a special focus on facies transitions. The internal CTD measures bathymetry, bottom water salinity and turbidity to identify changes of bottom water conditions and bathymetry, current induced sediment resuspension and potential transport pathways. According to own work and literature, four major sediment facies were defined from cored material that can be characterized by joint magnetic susceptibility and electric conductivity (porosity) measurements:

(1) The mud facies comprises fine-grained, mostly muddy Holocene high-stand sediments of high susceptibility and conductivity

(2) The mixed sand facies consists of relict and reworked siliciclastic and carbonatic sands with generally low magnetic susceptibility and intermediate to low conductivity;

(3) The glaucony facies consists of mostly relict, late Miocene sands containing paramagnetic glaucony, characterized by high susceptibility and low conductivity values;

(4) The gravel facies is dominated by shell fragments and coarse silicates and is characterized by a low susceptibility and an intermediate conductivity.

The empirical relation of the measured sediment conductivity σ_s, pore-water conductivity σ_w (approximately the CTD determined conductivity) and porosity ϕ is given by Archie's law:

$$\sigma_s = a \cdot \sigma_w \phi^m S_w^n ,$$

where constants m (the cementation factor), a and n can be determined from reference samples or chosen according to published values for the respective sediment type. Typical values for marine sands are $m = 1.5$ - 1.8 and $a = 1$. The pore water saturation factor S_w ($0 \leq S_w \leq 1$) is only relevant for marine sediments that include free gas or other pore space constituents.

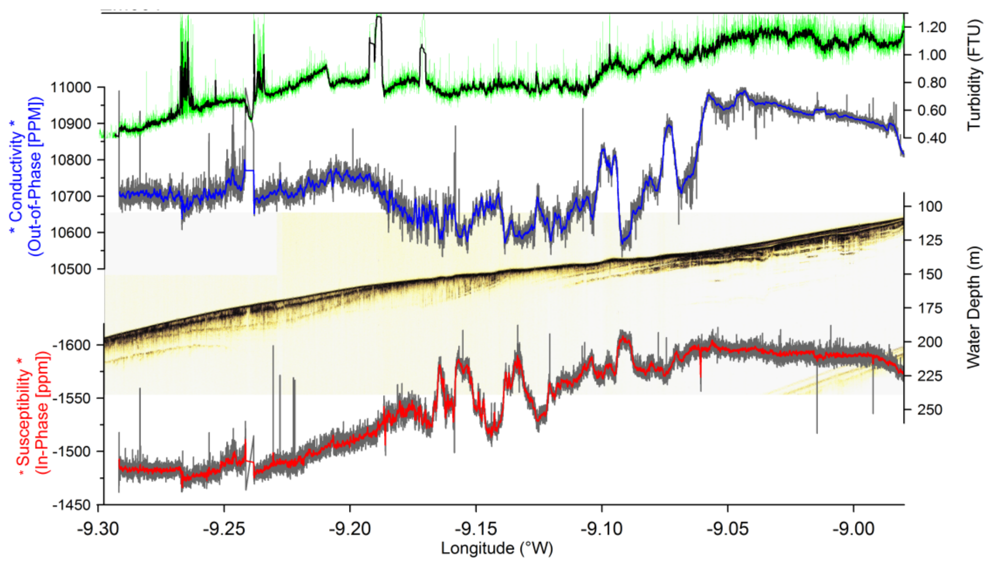


Fig. 5.15: W-E Profile EM001 crossing the Galician shelf at 42° 07' N.

The two exemplary profiles shown here, EM001 (WE profile at 42° 07' N; Fig. 5.15) and EM004 (SN profile on the outer shelf; Fig. 5.16), nicely summarize the vast variability and complexity of the shelf sediments and bottom water turbidity. The PARASOUND section in Figure 5.3 illustrates the modern Galician mud belt as an up to 6 m thick stratified Holocene mud lens deposited on top of older sand deposits. Noticeably, the turbidity shows enhanced values of approximately. 1.1 FTU on the mud belt. In the EM profiles, the mud-belt is represented by concurrent susceptibility and conductivity highs. Following the track from the inner shelf in westerly direction, the apparent magnetic susceptibility and electric conductivity rises over the mud belt until mid-shelf lithology changes (9.07° W or 125 m water depth) cause undulating and generally lower susceptibility and conductivity values reflecting bathymetrically recognizable bedform variations. A material change to more weakly magnetic sands occurs in 150 to 175 m water depth.

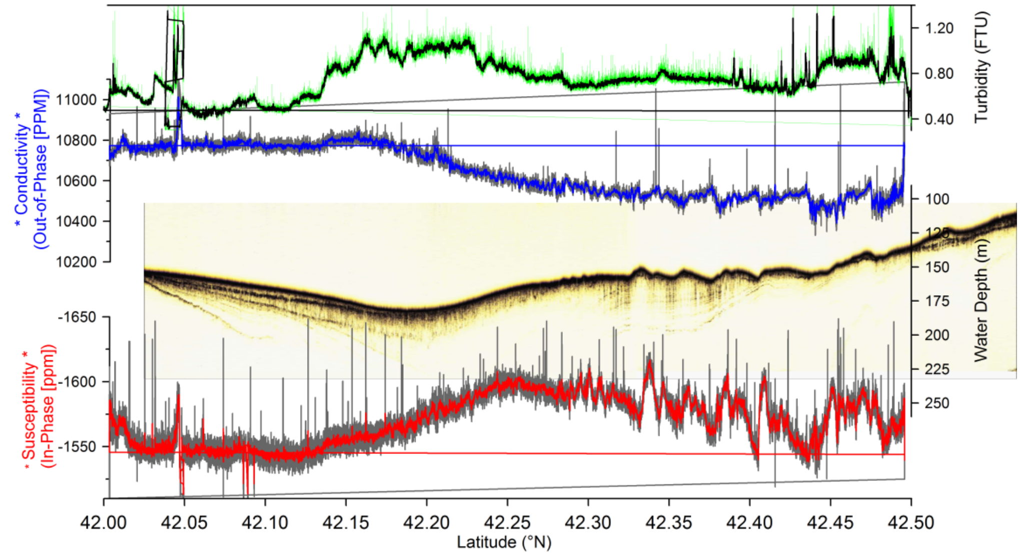


Fig. 5.16: S-N Profile EM004 parallel to the shelf break on the outer shelf.

Profile EM004 crosses profile EM 001 and follows the outer shelf roughly parallel to the shelf break in 130 to 170 m water depth. Following the profile from south to north, the PARASOUND image illustrates a lens like sediment wedge, where EM data indicate sediments of low susceptibility and intermediate conductivity – probably a mixed sand facies. Susceptibility values increase with fading thickness of the sediment wedge towards the center of a morphological depression (at about 42.13° N and 175 m water depth) and further rise on the northern flank of the depression, while the conductivity shows opposite behavior. Noticeable, the turbidity rises to values of 1.1 FTU within the depression, similar to magnitudes found on the mud belt in profile EM001. However, ADCP measurements (Chapter 5.8, Figure 5.25) show eastward directed currents, indicating upwelling conditions in this area at the time of transect. Between 42.27° N and 42.50° N undulating bathymetry, susceptibility and conductivity depicts another bedform dominated zone of preferentially highly compacted glaucony sands. Turbidity values raise high to about 1.1 FTU at the northernmost part of the profile.

5.4 Physical Properties Studies

(T. Frederichs, V. Alekseev, A. Andrade, B. Baasch, V. Bender, K.-H. Baumann, P. Behrens, T. v. Dobeneck, I. Germade, J. Hangen, C. Hilgenfeldt, J. Just, B. Kockisch, H. Lantzsch, A. Lipke, F.J. Lobo Sanchez, A. Mena Rodriguez, H. Müller, A. Petrovic, S. Roud, A.-I. Santos, I. Vogt)

Most of the sediment series recovered during METEOR Cruise M84-4 by vibro and gravity coring were subject to routine shipboard measurements of magnetic susceptibility (Table 3). These were performed on closed full cores. Magnetic susceptibility is closely related to sediment lithology and provides high-resolution core logs with a standard spacing of 2 cm. It was measured with a manually operated susceptibility logger. Data were automatically determined and stored by the system's personal computer. Additionally, we measured electrical resistivity with a 4-point probe on a series of short cores recovered by coring with giant box corer, multi-corer and Rumohr corer. In addition, oriented samples in cubic plastic boxes of 6.2 cm volume were taken from gravity cores on shelf locations. Non-oriented samples were taken during splitting of Rumohr cores (sampling scheme see Chapter 5.5), multi cores and giant box cores. The latter were sub-sampled before by pushing a plastic liner with 8 cm diameter into the sediment. Giant box corers were also sampled by a u-shaped plastic profile with a cross-section of about 2.5x2.5 cm. A Kautex bottle of 1-litre volume was taken from each grab sampler. Shore based environmental studies will be performed on these samples.

5.4.1 Physical Background and Experimental Techniques

5.4.1.1 Magnetic Susceptibility

The magnetic volume susceptibility κ is defined by the equations

$$B = \mu_0 \cdot \mu_r \cdot H = \mu_0 \cdot (1 + \kappa) \cdot H = \mu_0 \cdot H + \mu_0 \cdot \kappa \cdot H = B_0 + M$$

with magnetic induction B, absolute and relative permeabilities μ_0 and μ_r, magnetizing field H, magnetic volume susceptibility κ and volume magnetization M. As can be seen from the third term, κ is a dimensionless physical quantity. It records the amount to which a material is magnetized by an external magnetic field.

For marine sediments the magnetic susceptibility may vary from an absolute minimum value of $-15 \cdot 10^{-6}$ (diamagnetic minerals such as pure carbonate or silicate) to a maximum of some $10.000 \cdot 10^{-6}$ for basaltic debris rich in (titano-) magnetite. In most cases κ is primarily determined by the concentration of ferrimagnetic minerals, while paramagnetic matrix components such as clays are of minor importance. Enhanced susceptibilities indicate higher concentrations of lithogenic or authigenic components. This relation may serve for correlating sedimentary sequences deposited under similar global or regional conditions.

The core logger is mounted with a commercial BARTINGTON M.S.2 susceptibility meter with a 135 mm loop sensor. Due to the sensor's size, its sensitivity extends over a core interval of about 8 cm. Consequently, sharp susceptibility changes in the sediment column will appear smoothed in the κ core log and thin layers such as ashes cannot appropriately be resolved.

5.4.1.2 Electrical Resistivity and Porosity

The electrical sediment resistivity R_s was determined using a handheld *Lippmann 4point light 10W* (Lippmann, Schaufling, Germany) probe with a miniaturized four-electrodes-in-line ("Wenner") configuration (4 mm electrode spacing). The outer electrodes feed an alternating current of 15 mA maximum with a frequency of 4.16 Hz into the sediment. The resulting potential difference at the inner electrodes yields raw and calibrated values for conductivity and resistivity. Porosity may be calculated according to the empirical Archie's equation

$$R_s/R_w = k\cdot\phi^{-m}$$

where the ratio of sediment resistivity R_s and pore water resistivity R_w can be approximated by a power function of porosity ϕ. Following a recommendation by BOYCE (1968), suitable for sea water saturated clay-rich sediments, values of 1.30 and 1.45 were used for the constants k and m, respectively. The calculated porosity ϕ is subsequently converted to wet bulk density ρ_{wet} using the equation (BOYCE, 1976)

$$\rho_{wet} = \phi\cdot\rho_f + (1 - \phi)\cdot\rho_m$$

with a pore water density ρ_f of 1030 kg/m^3 and a matrix density ρ_m of 2670 kg/m^3. For a uniform treatment of all cores, these empirical coefficients were not adapted to individual sediment lithologies. Yet, relative porosity and density changes should be well documented.

The sensor was inserted into the sediments surface to a depth of about 1.5 cm before a new sediment slice of 2 cm thickness was removed from the core top. The sensor averages over approximately 0.6 cm core depth. A platinum thermometer inserted into the sediment measures sediment temperature for temperature compensation. Absolute sensor calibrations using a series of salt water standards are performed prior to the measurement of each core.

Electrical resistivity data are not presented here since they need further processing which was not performed on board.

5.4.2 Sampling Sites and Recovery

28 sediment cores with a cumulative length of 109.11 m from stations between 41°50’ and 42°50’ N and 9 and 10° W at the Iberian continental margin were investigated in terms of their physical properties (Table 3). The coring locations comprise sediments from water depths between about 101 m (GeoB 15631-2) and 2639 m (GeoB 15613-1). Core lengths varied between 0.6 m (GeoB 15622-2) and 8.74 m (GeoB 15613-1).

5.4.3 Preliminary Results

The general characteristics of magnetic susceptibility are compiled in Figure 5.17. Dots mark the mean values for the individual cores, vertical error bars denote their standard deviations. Each diagram is divided into groups of spatially adjacent cores. Overall mean magnetic susceptibility (Fig. 5.17) is about $217 \cdot 10^{-6}$ SI. The highest values of about almost $1000 \cdot 10^{-6}$ SI are found in the sediments of core GeoB15613-1 from the lower channel of Ria Arosa, where as the highest variability (standard deviation) are found in the sediments of core GeoB15673-1 from the mud belt off Ria de Vigo. Lowest mean susceptibility ($33 \cdot 10^{-6}$ SI) was determined for core GeoB15619-1 from a slide on the slope.

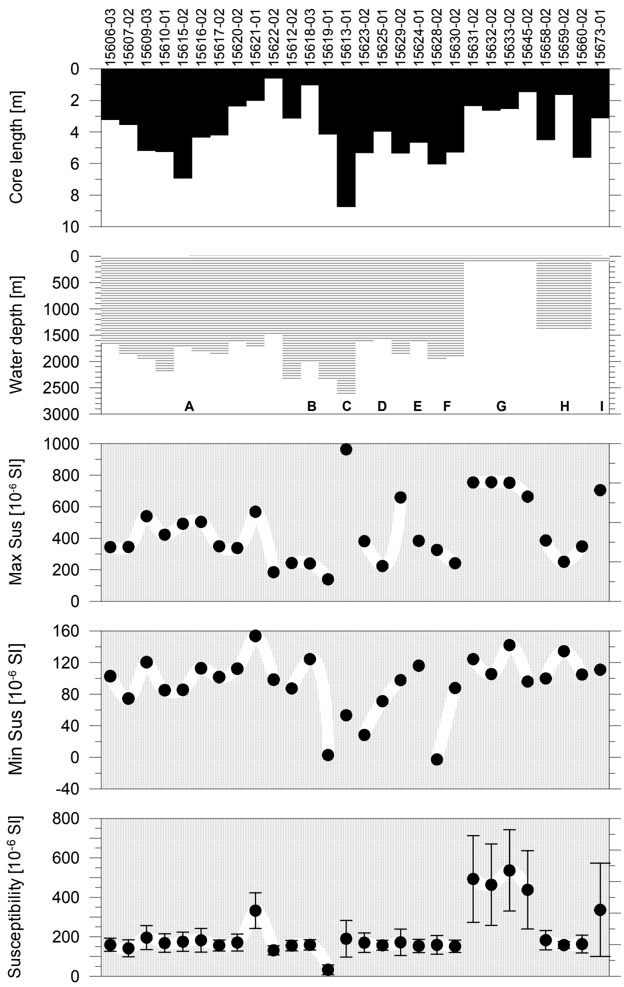


Fig. 5.17: Maximum, minimum and mean magnetic susceptibilities of cores GeoB 15606-3 through GeoB 15673-1 compared to variations in water depth at the sampling sites and core recovery. The vertical error bars denote standard deviations. Areas A through I are labelled according to Figure 5.18.

The heterogeneous sedimentary environment of the working area is reflected by missing general trends according to water depths or localities. Highest mean values (336 to 536·10^{-6} SI) were determined for near-shore sediments from shallow water depth at sites GeoB15631-2, 32-2, 33-2, 45-2 and 73-1. Only at location GeoB15621-1, located in a channel at 42.5°N/9.6°W in a water depth of 1740 m, a comparable high mean susceptibility of 333·10^{-6} SI was determined. All other sediments show mean susceptibility values of 100 to 200·10^{-6} SI, core GeoB15619-01 even a mean as low as 33·10^{-6} SI.

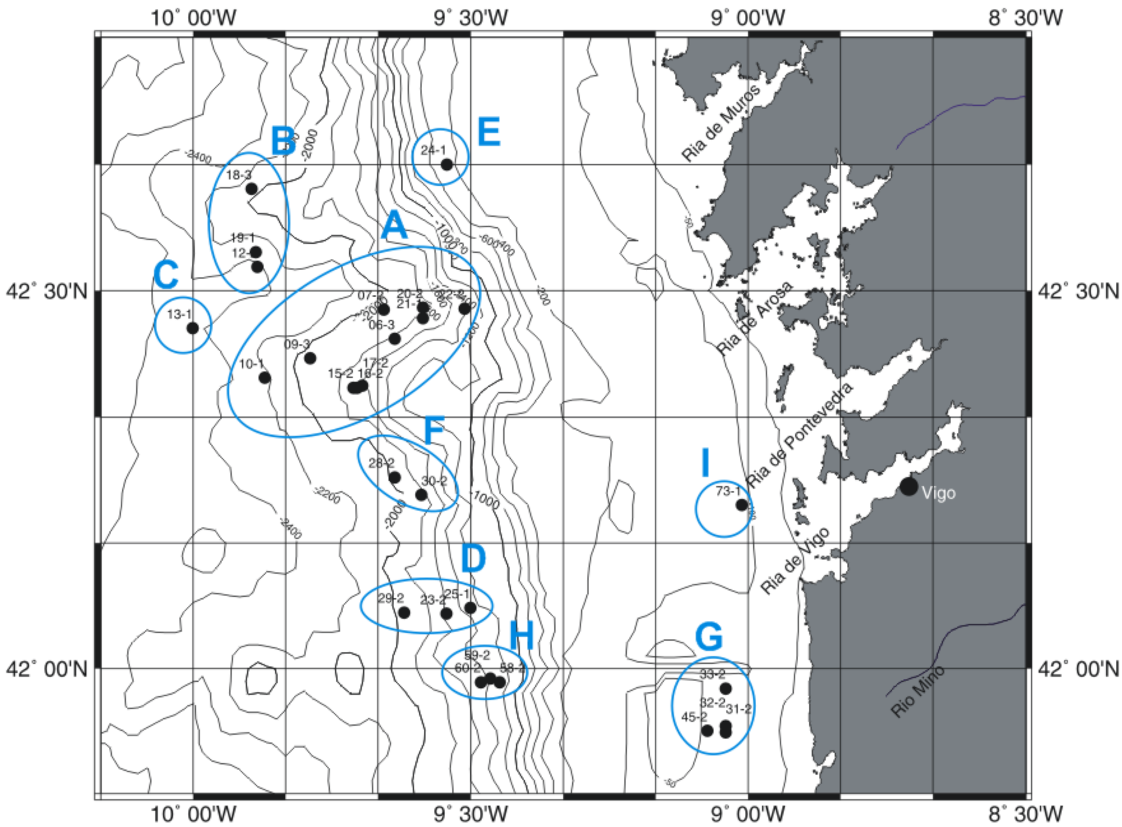


Fig. 5.18: Map of working area showing the locations of coring sites with magnetic susceptibility measured on board. Letters A through I indicate the grouping of the sediment cores as used in Figures 5.17 and 5.19.

According to the sampling sites we sub-divided all sediment cores in groups A through I (Fig. 5.17, 5.18). As an illustration for the different susceptibility patterns of the sediments, examples of each group are presented in Figure 5.19. As an example, Fig. 5.20 shows the electric resistivity profile of Rumohr core GeoB15662-1 as measured on board. Although the data may need further processing the record shows increasing values down-core indicating typically decreasing porosity with core depth. These data will be used for calibration purposes of the data collected with the electromagnetic profiler (see Chapter 5.3).

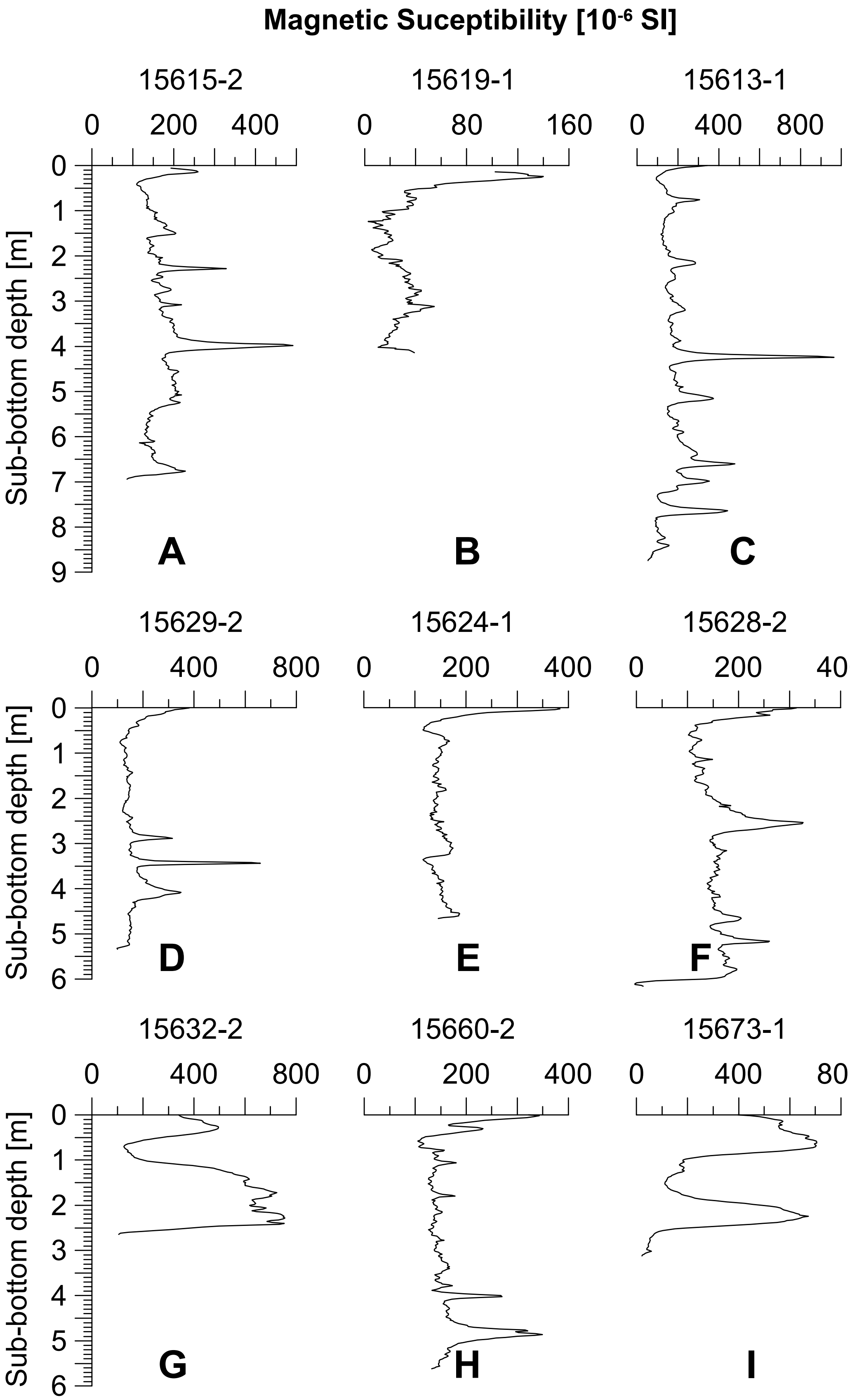


Fig. 5.19: Representative records of magnetic susceptibility for each group of sediment cores A through I (see also Figure 5.18).

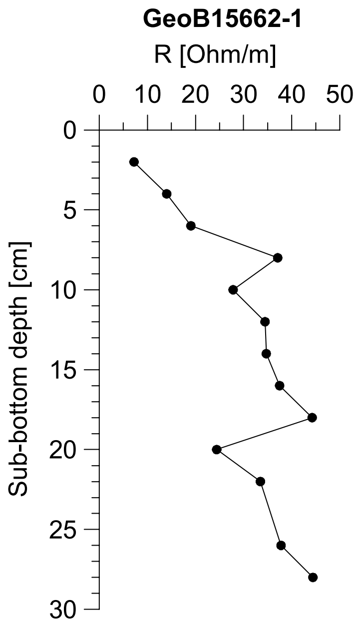


Fig. 5.20: Electric resistivity record of Rumohr core GeoB15662-1 as measured with Lippmann probe.

Table 3: Cores subject to physical properties measurements.

Core GeoB	Corer	Magnetic Suscept.	Electric Resist.
15606-03	Gravity	X	
15607-02	Gravity	X	
15609-03	Gravity	X	
15610-01	Gravity	X	
15612-02	Gravity	X	
15613-01	Gravity	X	
15615-02	Gravity	X	
15616-02	Gravity	X	
15617-02	Gravity	X	
15618-03	Gravity	X	
15619-01	Gravity	X	
15620-02	Gravity	X	
15621-01	Gravity	X	
15622-02	Gravity	X	
15623-02	Gravity	X	
15624-01	Gravity	X	
15625-01	Gravity	X	
15628-02	Gravity	X	
15629-02	Gravity	X	
15630-02	Gravity	X	
15631-01	MUC		X
15631-02	Gravity	X	
15632-01	MUC		X
15632-02	Gravity	X	
15633-01	MUC		X
15633-02	Gravity	X	X
15634-01	Giant box		X
15635-01	Giant box		X
15639-01	MUC		X
15640-01	MUC		X
15641-01	MUC		X
15642-01	MUC		X
15643-01	MUC		X
15644-01	MUC		X
15645-01	MUC		X
15645-02	Gravity	X	
15646-01	MUC		X
15648-03	Rumohr		X
15649-01	Rumohr		X
15650-01	Rumohr		X
15651-01	Rumohr		X
15652-01	Rumohr		X
15653-01	Rumohr		X
15654-01	Rumohr		X
15655-01	Rumohr		X
15656-01	Rumohr		X
15658-02	Gravity	X	
15659-02	Gravity	X	
15660-02	Gravity	X	
15661-01	Giant box		X
15662-01	Giant box		X
15663-02	Giant box		X
15664-01	Rumohr		X
15665-01	Rumohr		X
15666-01	Rumohr		X
15667-01	Rumohr		X
15668-01	Rumohr		X
15669-01	Rumohr		X
15670-01	Rumohr		X
15671-01	Rumohr		X
15672-01	Rumohr		X
15673-01	Gravity	X	
15673-02	Rumohr		X
15674-01	Rumohr		X
15675-01	Rumohr		X
15676-01	Rumohr		X
15677-01	Rumohr		X
15678-01	Rumohr		X
15679-01	Rumohr		X
15680-01	Rumohr		X
15681-01	Rumohr		X
15682-01	Rumohr		X
15683-01	Rumohr		X
15684-01	Rumohr		X
15685-01	Rumohr		X
15686-01	Rumohr		X
15687-01	Rumohr		X
15688-01	Rumohr		X
15689-01	Rumohr		X
15690-01	Rumohr		X
15691-01	Rumohr		X
15692-01	Rumohr		X
15693-02	Rumohr		X
15694-01	Rumohr		X
15695-01	Rumohr		X
15696-01	Rumohr		X
15697-01	Rumohr		X
15698-01	Rumohr		X
15699-01	Rumohr		X
15801-01	Rumohr		X
15802-01	Rumohr		X
15803-01	Rumohr		X
15804-02	Rumohr		X
15805-01	Rumohr		X
15806-01	Rumohr		X
15807-01	Rumohr		X
15808-01	Rumohr		X
15809-01	Rumohr		X

5.5 Sediment Surface Sampling and Shallow Coring

(V.B. Bender, A.I. dos S. Marques, I. Vogt)

5.5.1 Methods

During cruise M84/4 contrasting environmental settings have been targeted; on the one hand the current-influenced continental slope and interior basin with contourites, mass transport deposits, coarse-grained channel and canyon fills, and normal hemipelagic successions; and on the other hand the continental shelf with local mud depocenters, wave- and current-controlled sand covers, lee-side wedge-shaped sediment bodies, and ridge-and-trough systems were in the focus of the coring operations. Therefore, we have used a wide range of sampling tools.

Depending on the expected lithology at 105 of 110 stations either a Multicorer, a Giant Box Corer or a Rumohr Corer were deployed to recover the sediment surface and uppermost tens of centimeters in an as undisturbed as possible way (Fig. 5.21, A-C). In four cases we had to employ a Grab Sampler (Fig. 5.21, D) to obtain coarse surface sediments.

5.5.1.1 The Multicorer (MUC), *Multilot*

The MUC is designed to recover undisturbed surface sediments together with the supernatant bottom water. During M84/4 we employed a MUC equipped with eight large (10 cm in diameter) and 60-cm long transparent plastic tubes.

5.5.1.2 The Giant Box Corer (GBC), *Großkastengreifer*

The GBC, with a sampling area of 50 x 50 cm and a maximal penetration depth of 50 cm, was applied as a tool to provide an amount of surface material sufficiently enough for all involved research groups. The core recovery was variable due to the nature of the sampled material. After arriving on deck, the over-standing water was removed and the sediment surface was documented by visual description and photography. Then, liners were pressed in and surfaces samples were taken. Afterwards, the front wall was opened and the downcore profile was described, photographed and sampled. Finally, the liners were removed and savely stored.

5.5.1.3 The Rumohr Corer (RC), *Rumohrlot*

The RC is a small gravity corer with a simple plastic tube (100-cm long and 8 cm in diameter) and was deployed with a lead weight of 50 kg in top. The corer uses a tight-fitting lid closing the top of the coring tube during retrieval and thereby retaining the sediment core. With this device, likewise the MUC, it is possible to obtain an undisturbed sediment surface including the supernatant water and uppermost tens of centimeters, but with significantly longer core recovery. Another advantage against the MUC is also that sandy sediments can be easily obtained.

5.5.1.4 The Grab Sampler (GS), *Backengreifer*

A GS of the size 50 x 30 cm was used to collect a representative sample of the surface sediment, when the former coring devices did not work satisfactory due to the sediment properties. The bite of the sampler is about 20-cm deep providing a homogenized average sample. The closing mechanism prevents wash-out during retrieval, even when the sediments are exceptionally coarse-grained.

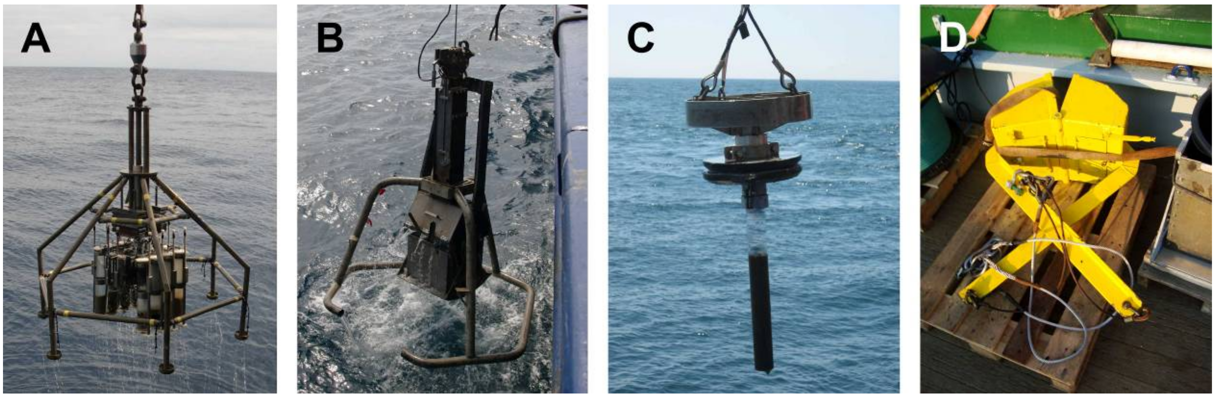


Fig. 5.21: Sediment surface sampling devices deployed during M84/4. A) Multicorer (MUC); B) Giant box corer (GBC); C) Rumohr corer (RC); D) Grab sampler (GS).

5.5.2 Material

5.5.2.1 Multicoring

The MUC was preferentially used at stations were we expected soft and cohesive, i.e., muddy sediments. At 24 stations we successfully retrieved the uppermost 10 to 41 cm with this device.

The general sampling scheme on deck was as follows:

Surface sediment (0 – 1 cm) from 1 tube was sampled for the investigation of coccolithophoride assemblages;

Surface sediment (0 – 1 cm) from 1 tube was sampled for the investigation of foraminiferal assemblages (only at Stations GeoB 15631, GeoB 15632 and GeoB 15633);

1 tube was cut into 1 cm slices for sedimentological analyses;

1 tube was cut into 1 cm slices for proxy calibration for the CALIBERIA project (E. Salgueiro);

1 tube was frozen for biogeochemical analyses;

1 large tube was sampled with environmental magnetic cubes and slices every 2 cm, as well as measured for resistivity (every 2 cm) and temperature (every 10 cm); only at stations GeoB 15631, GeoB 15632, GeoB 15633, GeoB 15639, GeoB 15640, GeoB 15641, GeoB 15642, GeoB 15643, GeoB 15644, GeoB 15645 and GeoB 15646.

Table 4: MUC stations list

GeoB No.	Ships station number	Date 2011	Gear	Gear Abbreviation	Time Sea floor (UTC)	Coordinates		Water Depth (m)
						Latitude	Longitude	
15606-2	ME844/358	04.05.11	Multicorer	MUC	09:46	42° 26,21' N	9° 38,21' W	1656
15609-2	ME844/365	05.05.11	Multicorer	MUC	06:30	42° 24,65' N	9° 47,35' W	1935
15610-2	ME844/368	05.05.11	Multicorer	MUC	12:54	42° 23,12' N	9° 52,26' W	2215
15613-2	ME844/375	07.05.11	Multicorer	MUC	13:20	42° 27,05' N	10° 03,00' W	2639
15614-1	ME844/379	10.05.11	Multicorer	MUC	04:26	42° 23,08' N	9° 36,64' W	1029
15615-1	ME844/380	10.05.11	Multicorer	MUC	06:41	42° 22,23' N	9° 42,70' W	1709
15618-2	ME844/388	11.05.11	Multicorer	MUC	00:10	42° 38,05' N	9° 53,66' W	2000
15619-2	ME844/391	11.05.11	Multicorer	MUC	07:41	42° 33,08' N	9° 53,21' W	2359
15620-1	ME844/392	11.05.11	Multicorer	MUC	11:07	42° 28,66' N	9° 35,16' W	1625
15621-2	ME844/395	11.05.11	Multicorer	MUC	16:51	42° 27,88' N	9° 35,19' W	1742
15622-1	ME844/396	11.05.11	Multicorer	MUC	18:50	42° 28,61' N	9° 30,64' W	1472
15627-1	ME844/406	14.05.11	Multicorer	MUC	05:11	42° 15,49' N	9° 35,64' W	1903
15628-1	ME844/407	14.05.11	Multicorer	MUC	07:20	42° 15,21' N	9° 38,20' W	1961
15629-1	ME844/408	14.05.11	Multicorer	MUC	09:19	42° 14,47' N	9° 37,20' W	1885
15631-1	ME844/415	15.05.11	Multicorer	MUC	13:13	41° 54,90' N	9° 02,42' W	102
15632-1	ME844/416	15.05.11	Multicorer	MUC	13:40	41° 55,40' N	9° 02,42' W	103
15633-1	ME844/417	15.05.11	Multicorer	MUC	14:23	41° 58,41' N	9° 02,43' W	110
15639-1	ME844/435	18.05.11	Multicorer	MUC	22:11	42° 07,01' N	9° 05,46' W	135
15640-1	ME844/436	18.05.11	Multicorer	MUC	23:08	42° 07,00' N	9° 04,07' W	132
15641-1	ME844/437	19.05.11	Multicorer	MUC	00:08	42° 07,00' N	9° 02,67' W	128
15642-1	ME844/438	19.05.11	Multicorer	MUC	01:08	42° 07,00' N	8° 59,71' W	110
15643-1	ME844/439	19.05.11	Multicorer	MUC	02:12	42° 07,00' N	8° 58,81' W	105
15644-1	ME844/440	19.05.11	Multicorer	MUC	03:47	41° 55,01' N	9° 00,00' W	87
15645-1	ME844/441	19.05.11	Multicorer	MUC	04:30	41° 55,01' N	9° 04,01' W	117
15646-1	ME844/442	19.05.11	Multicorer	MUC	05:15	41° 55,00' N	9° 06,01' W	122

5.5.2.2 Giant Box Coring:

At 25 stations, where sandy sediments were either expected or where a larger amount of sediment material was needed, we deployed the GBC. Recovery with the GBC was ranging from 10 cm to 46 cm. After detailed visual description and photographic documentation of the sediment surface, the sampling scheme for GBC material was as follows:

10 x 10 cm sample of the surface sediment (0 – 1 cm) for sedimentological analyses;

5 x 5 cm sample of the surface sediment (0 – 1 cm) for the investigation of coccolithophoride assemblages;

20 x 20 cm sample of the surface sediment (0 – 1 cm) for proxy calibration analyses of the CALIBERIA project (E. Salgueiro);

1 large (∅ 12 cm) core for sedimentological analyses;

1 large (∅ 12 cm) core for archive purposes;

1 small (∅ 8 cm) core and a cube of the surface sediment (0 – 2 cm) for environmental magnetic; only at stations GeoB 15634 (cube sample only), GeoB 15661, GeoB 15662 and GeoB 15663.

Table 5: Giant Box Corer stations

GeoB No.	Ships station number	Date 2011	Gear	Gear Abbreviation	Time Sea floor (UTC)	Coordinates		Water Depth (m)
						Latitude	Longitude	
15601-1	ME844/351	02.05.11	Gaint Box Corer	GBC	7:48	42° 05,39' N	9° 24,82' W	867
15602-1	ME844/352	02.05.11	Gaint Box Corer	GBC	09:03	42° 05,19' N	9° 26,38' W	1092
15603-1	ME844/353	02.05.11	Gaint Box Corer	GBC	10:33	42° 04,89' N	9° 28,60' W	1426
15604-1	ME844/354	02.05.11	Gaint Box Corer	GBC	12:18	42° 04,79' N	9° 30,01' W	1598
15605-1	ME844/356	04.05.11	Gaint Box Corer	GBC	06:27	42° 30,58' N	9° 30,45' W	1524
15607-1	ME844/360	04.05.11	Gaint Box Corer	GBC	13:54	42° 28,53' N	9° 39,39' W	1883
15608-1	ME844/362	04.05.11	Gaint Box Corer	GBC	18:00	42° 30,20' N	9° 40,23' W	2043
15611-1	ME844/369	05.05.11	Gaint Box Corer	GBC	16:01	42° 32,28' N	9° 53,12' W	2420
15612-1	ME844/370	05.05.11	Gaint Box Corer	GBC	18:11	42° 31,87' N	9° 53,08' W	2359
15614-2	ME844/386	10.05.11	Gaint Box Corer	GBC	18:53	42° 23,08' N	9° 36,63' W	1028
15616-1	ME844/381	10.05.11	Gaint Box Corer	GBC	08:34	42° 22,34' N	9° 42,31' W	1792
15617-1	ME844/382	10.05.11	Gaint Box Corer	GBC	10:22	42° 22,49' N	9° 41,72' W	1860
15623-1	ME844/399	12.05.11	Gaint Box Corer	GBC	09:30	42° 04,35' N	9° 32,65' W	1617
15630-1	ME844/409	14.05.11	Gaint Box Corer	GBC	11:45	42° 13,81' N	9° 35,35' W	1891
15634-1	ME844/430	18.05.11	Gaint Box Corer	GBC	18:41	42° 06,99' N	9° 16,74' W	179
15635-1	ME844/431	18.05.11	Gaint Box Corer	GBC	19:42	42° 06,97' N	9° 11,80' W	160
15623-4	ME844/462	19.05.11	Giant Box Corer	GBC	19:40	42° 04,34' N	9° 32,69' W	1616
15624-2	ME844/463	19.05.11	Giant Box Corer	GBC	21:11	42° 03,94' N	9° 32,66' W	1636
15657-1	ME844/466	20.05.11	Giant Box Corer	GBC	05:08	41°59,177' N	9° 25,649' W	1327
15658-1	ME844/467	20.05.11	Giant Box Corer	GBC	06:36	41°58,731' N	9° 26,660' W	1389
15659-1	ME844/468	20.05.11	Giant Box Corer	GBC	08:17	41°59,200' N	9° 27,927' W	1406
15660-1	ME844/470	20.05.11	Giant Box Corer	GBC	11:21	41°58,980' N	9° 28,681' W	1402
15661-1	ME844/479	21.05.11	Giant Box Corer	GBC	12:40	42°20,248' N	9° 12,022' W	145
15662-1	ME844/480	21.05.11	Giant Box Corer	GBC	13:22	42°21,267' N	9° 12,403' W	150
15663-2	ME844/484	21.05.11	Giant Box Corer	GBC	17:52	42°30,224' N	9° 15,711' W	126

5.5.2.3 Rumohr Coring

For soft and cohesive sediments on the shelf in water depths shallower 350 m we deployed the RC. With the RC we successfully retrieved undisturbed surface sediments including the supernatant bottom water as well as the uppermost 15 to 75 cm, in total at 60 stations. In generally each RC was sampled on one halve in 2-cm slices for environmental magnetic analyses, also including environmental magnetic cube samples every 2 cm; the other halve was sampled in 1-cm slices for sedimentological analyses (Fig. 5.22, A). At stations GeoB 15671 to 15680, GeoB 15683 and GeoB 15687 (Galicia mud belt) syringe samples from the sedimentology sampling halve of the cores were taken every 5 cm for density calculations (Fig. 5.22, B).

For the CALIBERIA project Cores GeoB 15648-2 and GeoB 15656-2 were collected and sampled for every 1 cm. The latter was shared: one half was sampled in 1-centimeter slices for the CALIBERIA project, and the environmental magnetics (cube samples every 2 cm) and geology/sedimentology (1-cm slice) groups of MARUM sampled the other half.

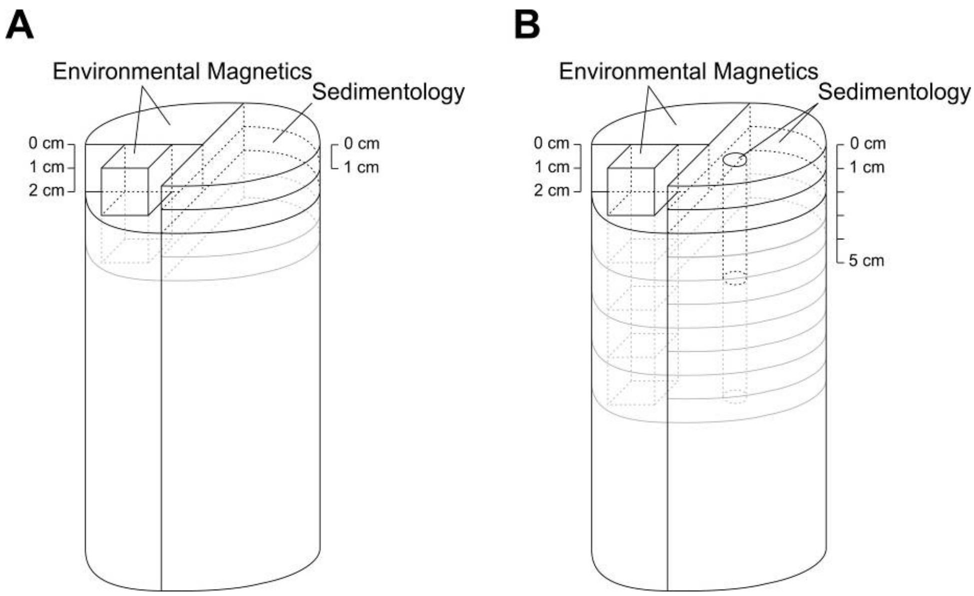


Fig. 5.22: A) General sampling scheme for Rumohr cores. B) Including a syringe sample every 5 cm.

Table 6: Rumohr Corer stations

GeoB No.	Ships station number	Date 2011	Gear	Gear Abbreviation	Time Sea floor (UTC)	Coordinates		Water Depth (m)
						Latitude	Longitude	
15648-1	ME844/447	19.05.11	Rumohr Corer	RC	10:03	42°07,011' N	9° 01,494' W	115
15648-2	ME844/448	19.05.11	Rumohr Corer	RC	10:29	42°07,012' N	9° 01,495' W	115
15648-3	ME844/449	19.05.11	Rumohr Corer	RC	10:43	42°07,014' N	9° 01,493' W	116
15649-1	ME844/450	19.05.11	Rumohr Corer	RC	11:25	42°07,00' N	9° 03,43' W	126
15650-1	ME844/451	19.05.11	Rumohr Corer	RC	12:15	42°06,999' N	9° 04,386' W	129
15651-1	ME844/452	19.05.11	Rumohr Corer	RC	12:58	42°07,00' N	9° 05,96' W	135
15652-1	ME844/453	19.05.11	Rumohr Corer	RC	13:35	42°07,00' N	9° 07,05' W	138
15653-2	ME844/455	19.05.11	Rumohr Corer	RC	14:47	42°07,01' N	9° 08,54' W	144
15654-1	ME844/456	19.05.11	Rumohr Corer	RC	15:21	42°07,00' N	9° 10,55' W	149
15654-2	ME844/457	19.05.11	Rumohr Corer	RC	15:35	42°07,004' N	9° 10,556' W	149
15655-1	ME844/458	19.05.11	Rumohr Corer	RC	16:08	42°07,007' N	9° 12,229' W	160
15656-2	ME844/460	19.05.11	Rumohr Corer	RC	17:30	42°06,991' N	9° 20,002' W	220

GeoB No.	Ships station number	Date 2011	Gear	Gear Abbreviation	Time Sea floor (UTC)	Coordinates		Water Depth (m)
15664-1	ME844/488	23.05.11	Rumohr Corer	RC	07:12	42°04,255' N	9° 08,800' W	139
15665-1	ME844/489	23.05.11	Rumohr Corer	RC	07:53	42°04,255' N	9° 06,245' W	132
15666-1	ME844/490	23.05.11	Rumohr Corer	RC	08:27	42°04,249' N	9° 04,673' W	130
15667-1	ME844/491	23.05.11	Rumohr Corer	RC	08:55	42°04,253' N	9° 04,456' W	129
15668-1	ME844/492	23.05.11	Rumohr Corer	RC	09:27	42°04,231' N	9° 03,887' W	126
15669-1	ME844/493	23.05.11	Rumohr Corer	RC	09:58	42°04,255' N	9° 03,630' W	125
15670-1	ME844/494	23.05.11	Rumohr Corer	RC	10:36	42°04,24' N	9° 02,889'W	122
15671-1	ME844/495	23.05.11	Rumohr Corer	RC	11:21	42°04,244' N	9° 00,176' W	104
15672-1	ME844/496	23.05.11	Rumohr Corer	RC	12:13	42°09,997' N	8° 59,028' W	102
15673-2	ME844/499	23.05.11	Rumohr Corer	RC	14:18	42°12,998' N	9° 00,680' W	112
15674-1	ME844/500	23.05.11	Rumohr Corer	RC	15:00	42°15,990' N	8° 58,864' W	95
15675-1	ME844/501	23.05.11	Rumohr Corer	RC	15:34	42°16004' N	9° 02,290' W	116
15675-2	ME844/502	23.05.11	Rumohr Corer	RC	15:49	42°16,004' N	9° 02,290' W	117
15676-1	ME844/503	23.05.11	Rumohr Corer	RC	16:18	42°15,998' N	9° 04,277' W	123
15677-1	ME844/504	23.05.11	Rumohr Corer	RC	17:05	42°19,012' N	9° 00,033' W	95
15678-1	ME844/505	23.05.11	Rumohr Corer	RC	17:41	42°18,993' N	9° 01,486' W	106
15679-1	ME844/506	23.05.11	Rumohr Corer	RC	18:18	42°20,334' N	9° 02,920' W	112
15680-1	ME844/507	23.05.11	Rumohr Corer	RC	19:05	42°19,007' N	9° 07,002' W	135
15681-1	ME844/508	23.05.11	Rumohr Corer	RC	19:45	42°18,524' N	9° 09,999' W	143
15682-1	ME844/509	23.05.11	Rumohr Corer	RC	20:15	42°18,798' N	9° 10,457' W	145
15683-1	ME844/510	23.05.11	Rumohr Corer	RC	21:13	42°20,840' N	9° 09,041' W	138
15684-1	ME844/511	23.05.11	Rumohr Corer	RC	22:18	42°27,689' N	9° 06,512' W	97
15685-1	ME844/512	23.05.11	Rumohr Corer	RC	23:30	42°28,303' N	9° 10,502' W	114
15686-1	ME844/513	23.05.11	Rumohr Corer	RC	23:59	42°28,849' N	9° 10,500' W	109
15687-1	ME844/514	24.05.11	Rumohr Corer	RC	00:25	42°29,297' N	9° 10,502' W	100
15688-1	ME844/515	24.05.11	Rumohr Corer	RC	01:59	42°24,641' N	9° 21,000' W	328
15689-1	ME844/516	24.05.11	Rumohr Corer	RC	02:53	42°27,099' N	9° 21,005' W	300
15690-1	ME844/517	24.05.11	Rumohr Corer	RC	03:32	42°27,633' N	9° 19,711' W	251
15691-1	ME844/518	24.05.11	Rumohr Corer	RC	04:12	42°26,862' N	9° 19,715' W	275
15692-1	ME844/519	24.05.11	Rumohr Corer	RC	04:55	42°26,332' N	9° 21,002' W	324
15693-1	ME844/520	24.05.11	Rumohr Corer	RC	05:30	42°25,700' N	9° 21,841' W	220
15693-2	ME844/521	24.05.11	Rumohr Corer	RC	05:55	42°25,700' N	9° 21,840' W	350
15694-1	ME844/536	25.05.11	Rumohr Corer	RC	20:10	42°29,13' N	9° 15,330' W	134
15695-1	ME844/537	25.05.11	Rumohr Corer	RC	20:43	42°28,508' N	9° 15,073' W	139
15696-1	ME844/538	25.05.11	Rumohr Corer	RC	21:09	42°28,226' N	9° 14,991' W	136
15697-1	ME844/539	25.05.11	Rumohr Corer	RC	21:46	42°27,098' N	9° 14,588' W	144
15698-1	ME844/540	25.05.11	Rumohr Corer	RC	22:30	42°26,41' N	9° 14,310' W	150
15699-1	ME844/541	25.05.11	Rumohr Corer	RC	23:19	42°24,576' N	9° 13,636' W	148
15801-1	ME844/542	25.05.11	Rumohr Corer	RC	00:01	42°24,221' N	9° 13,507' W	152
15802-1	ME844/543	25.05.11	Rumohr Corer	RC	00:50	42°22,622' N	9° 12,918' W	153
15803-1	ME844/544	25.05.11	Rumohr Corer	RC	01:42	42°19,921' N	9° 11,933' W	151
15804-1	ME844/545	25.05.11	Rumohr Corer	RC	02:36	42°15,207' N	9° 12,550' W	159
15804-2	ME844/546	25.05.11	Rumohr Corer	RC	02:51	42°15,208' N	9° 12,551' W	160
15805-1	ME844/547	25.05.11	Rumohr Corer	RC	03:25	42°13,297' N	9° 12,824' W	170
15806-1	ME844/548	25.05.11	Rumohr Corer	RC	04:26	42°06,452' N	9° 13,779' W	159
15807-1	ME844/549	25.05.11	Rumohr Corer	RC	05:22	42°00,572' N	9° 14,599' W	147
15808-1	ME844/550	25.05.11	Rumohr Corer	RC	07:02	42°10,01' N	9° 09,850' W	147
15809-1	ME844/551	25.05.11	Rumohr Corer	RC	07:41	42° 10,02' N	9° 13,040' W	170

5.5.2.4 Grab Sampling

The GS was depoyed at 4 stations only to obtain material from difficult-to-core locations.

Table 7: Grab Sampler stations

GeoB No.	Ships station number	Date 2011	Gear	Gear Abbreviation	Time Sea floor (UTC)	Coordinates		Water Depth (m)
						Latitude	Longitude	
15636-1	ME844/432	18.05.11	Grab Sampler	GS	20:36	42° 06,99' N	9° 09,35' W	147
15637-1	ME844/433	18.05.11	Grab Sampler	GS	21:07	42° 07,01' N	9° 07,96' W	143
15638-1	ME844/434	18.05.11	Grab Sampler	GS	21:36	42° 07,01' N	9° 06,85' W	141
15687-2	ME844/526	24.05.11	Grab Sampler	GS	10:23	42°29,311' N	9° 10,502' W	100

5.6 Sediment Coring

(T.J.J. Hanebuth, W. Alekseev, P. Behrens, J. Hangen, B. Kockisch, H. Lantzsch, A. Lipke, F.J. Lobo Sánchez, A. Mena Rodríguez, A. Petrovic)

5.6.1 Methods

During cruise M84/4 contrasting environmental settings have been targeted, although adjacently located to each other. The current-dominated coarse-grained continental shelf, locally protected mud deposits in shallow waters, the like-wise current-controlled upper to lower portions of the continental slope (canyon systems, gravity mass movement, contourites), and hemipelagic muds from the continental rise were cored during operations. Therefore, we have used two sampling tools for deeper sediment penetration:

5.6.1.1 The Gravity Corer (GC), *Schwerelot*

During the M84/4 cruise, 40 sediment cores were recovered using a Gravity Corer with station-individual lengths of 3, 6, or 12, respectively (Tab. 8). The top weight was a bit less than 1.5 tons. In some cases we have supported the core catcher with plastic film as an attempt to prevent the loss of sandy material in the water column. The gravity corer was deployed in the deep sea during the first leg of this cruise and on the shelf where the sediments were fine enough to allow gravity-driven penetration (mud depocenters).

5.6.1.2 The Vibrocorer (VC), *Vibrolot*

A VKG-5 Vibrocorer (VC) was of essential use to obtain sub-bottom samples from coarse-grained shelf areas. The VC owned by MARUM/Senckenberg has a maximum core length of

504 cm and a diameter of 10 cm. Deployed with a 300-m long electricity cable, which is run parallel to the wire by hand, coring in a maximum water depth of 220 m is possible during calm weather conditions.

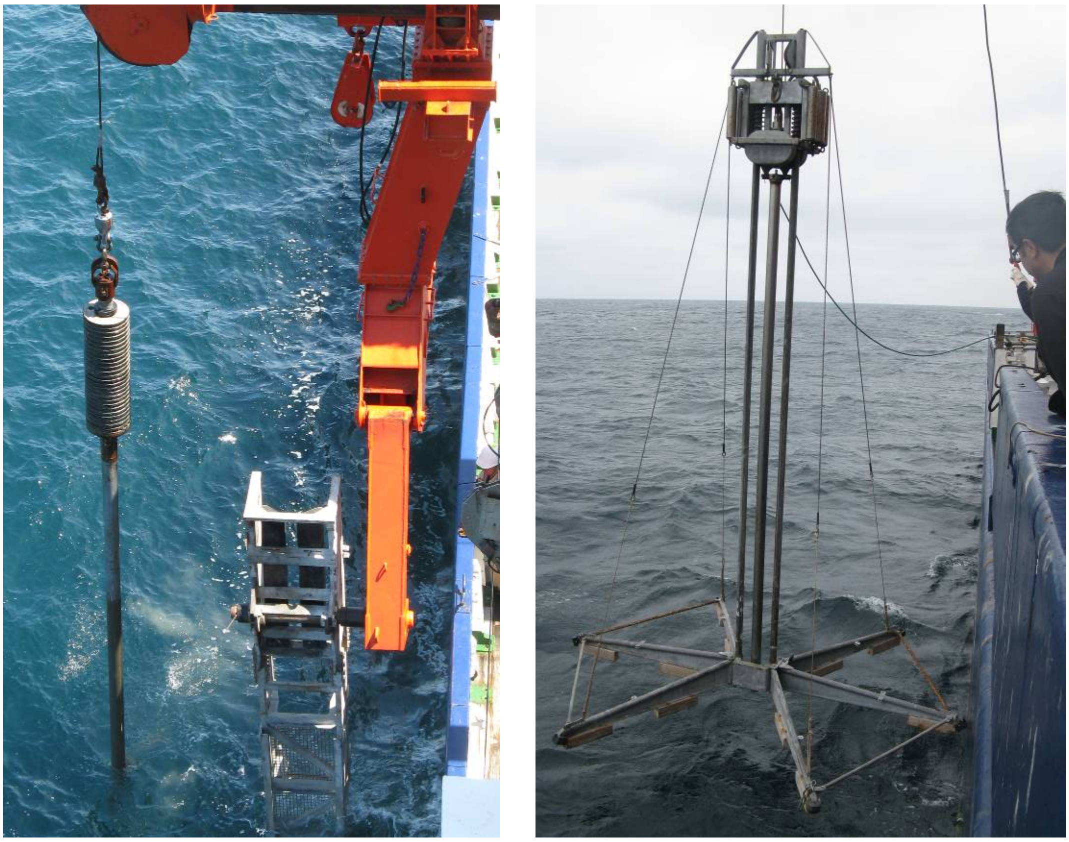


Fig. 5.23: The Gravity corer (left) and the Vibrocorer (right).

5.6.2 Material

5.6.2.1 Gravity Coring

We have deployed the Gravity Corer at 40 stations. Of these, 28 were located on the continental slope (e.g., inside gullies, in locally confined depocenters on the slope foot, at contourite deposits) and in the open interior basin (e.g., hemipelagic to contouritic deposits, distal channel bases, mass-transported deposits). The other 12 gravity cores were taken on the continental shelf around 100 m water depth (mid-shelf mud depocenters).

After retrieval, the core liners were cut into 1-m long sections, closed with caps and labelled according to the general GeoB scheme. Afterwards the cores were cut down-core into two halves; one half containing the *Work* and the other the *Archive* material.

Each core was documented by a detailed lithological core description and core photography. Colours were identified following MUNSELL soil colour chart. Special efforts were made for a detailed description of deposits with a significant internal structure inventory, such as resulting from gravity-driven processes.

Tab. 8: List of GRAVITY CORER stations.

GeoB No.	Ships station number	Date 2011	Gear	Gear Abbreviation	Time Sea floor (UTC)	Coordinates		Water Depth (m)
						Latitude	Longitude	
15606-3	ME844/359	04.05.11	Gravity Corer	GC-6	11:44	42° 26,21' N	9° 38,21' W	1655
15607-2	ME844/361	04.05.11	Gravity Corer	GC-6	15:48	42° 28,53' N	9° 39,39' W	1883
15609-3	ME844/366	05.05.11	Gravity Corer	GC-6	08:37	42° 24,65' N	9° 47,35' W	1935
15610-1	ME844/367	05.05.11	Gravity Corer	GC-6	10:58	42° 23,12' N	9° 52,26' W	2214
15611-2	ME844/373	05.05.11	Gravity Corer	GC-6	07:49	42° 32,27' N	9° 53,10' W	2415
15612-2	ME844/371	05.05.11	Gravity Corer	GC-3	20:37	42° 31,88' N	9° 53,09' W	2359
15613-1	ME844/374	07.05.11	Gravity Corer	GC-12	11:06	42° 27,05' N	10° 03,00' W	2639
15615-2	ME844/385	10.05.11	Gravity Corer	GC-12	16:34	42° 22,22' N	9° 42,70' W	1708
15616-2	ME844/384	10.05.11	Gravity Corer	GC-6	14:36	42° 22,34' N	9° 42,31' W	1794
15617-2	ME844/383	10.05.11	Gravity Corer	GC-6	12:25	42° 22,49' N	9° 41,72' W	1859
15618-3	ME844/389	11.05.11	Gravity Corer	GC-12	02:30	42° 38,05' N	9° 53,66' W	2000
15619-1	ME844/390	11.05.11	Gravity Corer	GC-6	05:32	42° 33,08' N	9° 53,21' W	2356
15620-2	ME844/393	11.05.11	Gravity Corer	GC-12	13:02	42° 28,66' N	9° 35,16' W	1625
15621-1	ME844/394	11.05.11	Gravity Corer	GC-6	15:01	42° 27,86' N	9° 35,18' W	1740
15622-2	ME844/397	11.05.11	Gravity Corer	GC-12	21:04	42° 28,61' N	9° 30,64' W	1471
15623-2	ME844/400	12.05.11	Gravity Corer	GC-6	11:21	42° 04,35' N	9° 32,65' W	1619
15624-1	ME844/401	12.05.11	Gravity Corer	GC-6	13:14	42° 03,97' N	9° 32,58' W	1639
15625-1	ME844/402	12.05.11	Gravity Corer	GC-6	14:58	42° 04,81' N	9° 30,02' W	1598
15626-1	ME844/403	12.05.11	Gravity Corer	GC-6	16:37	42° 05,20' N	9° 26,39' W	1089
15628-2	ME844/412	14.05.11	Gravity Corer	GC-12	17:58	42° 15,21' N	9° 38,20' W	1965
15629-2	ME844/407	14.05.11	Gravity Corer	GC-6	15:48	42° 14,47' N	9° 37,19' W	1885
15630-2	ME844/410	14.05.11	Gravity Corer	GC-6	13:43	42° 13,81' N	9° 35,35' W	1891
15631-2	ME844/420	15.05.11	Gravity Corer	GC-3	16:26	41° 54,91' N	9° 02,42' W	101
15632-2	ME844/419	15.05.11	Gravity Corer	GC-3	15:52	41° 55,41' N	9° 02,42' W	103
15633-2	ME844/418	15.05.11	Gravity Corer	GC-3	15:03	41° 58,41' N	9° 02,43' W	109
15644-2	ME844/445	19.05.11	Gravity Corer	GC-6	07:38	41° 55,02' N	9° 00,01' W	83
15645-2	ME844/444	19.05.11	Gravity Corer	GC-6	06:48	41° 55,01' N	9° 04,00' W	116
15646-2	ME844/443	19.05.11	Gravity Corer	GC-6	06:05	41° 55,00' N	9° 06,01' W	122
15657-2	ME844/474	20.05.11	Gravity Corer	GC-6	18:27	41°59,198' N	9° 25,629' W	1327
15657-3	ME844/475	20.05.11	Gravity Corer	GC-2.5	19:51	41°59,200' N	9° 25,629' W	1326
15658-2	ME844/473	20.05.11	Gravity Corer	GC-6	16:45	41°58,726' N	9° 26,650' W	1393
15659-2	ME844/472	20.05.11	Gravity Corer	GC-6	15:05	41°59,184' N	9° 27,916' W	1406
15660-2	ME844/471	20.05.11	Gravity Corer	GC-12	13:00	41°58,980' N	9° 28,681' W	1402
15672-2	ME844/497	23.05.11	Gravity Corer	GC-6	12:48	42°09,998' N	8° 59,027' W	103
15673-1	ME844/498	23.05.11	Gravity Corer	GC-6	13:44	42°12,998' N	9° 00,679' W	111
15679-2	ME844/554	27.05.11	Gravity Corer	GC-6	11:59	42°20,33' N	9° 02,920' W	112
15685-2	ME844/524	24.05.11	Gravity Corer	GC-3	09:11	42°28,32' N	9° 10,510' W	114
15686-2	ME844/525	24.05.11	Gravity Corer	GC-3	09:40	42°28,86' N	9° 10,500' W	111
15687-3	ME844/527	24.05.11	Gravity Corer	GC-3	10:46	42°29,310' N	9° 10,501' W	100
15688-2	ME844/522	24.05.11	Gravity Corer	GC-12	07:10	42°24,651' N	9° 21,008' W	326

From the working half, 2 series of syringe samples (10 cc) were taken in 10-cm steps for sedimentological, palaeoceanographic and geochemical purposes. This scheme was not followed in some cases to avoid a blind and destructive sampling of horizons (such as turbiditic beds) that are of significance in terms of understanding their formation process are for the associated MARUM projects.

5.6.2.2 Vibro Coring

During the cruise M84/4, we took 8 sediment cores with the Vibrocorer from water depths between 101 and 151 m (Tab. 9). We mainly targeted local sandy depocenters on the mid to outer continental shelf as well as special structures such as ridge-like elements on the outer shelf to receive material from the active (?) sediment transport routes. The corer worked well and most of these cores came to the maximum recovery of about 500 cm.

Once a core was back on deck, the plastic liners were cut into 1-m long sections, closed with caps and labelled according the scheme generally applied to GeoB cores. We did not further work on these sections (no opening during the cruise) to prevent further disturbance of th is generally coarse-grained, well sorted and un-cohesive material.

Table 9: List of VIBROCORER stations.

GeoB No.	Ships station number	Date 2011	Gear	Gear Abbreviation	Time Sea floor (UTC)	Coordinates		Water Depth (m)
						Latitude	Longitude	
15661-2	ME844/482	21.05.11	Vibro Corer	VC	15:24	42°20,244' N	9° 12,025' W	146
15662-2	ME844/481	21.05.11	Vibro Corer	VC	14:26	42°21,268' N	9° 12,403' W	151
15683-2	ME844/529	24.05.11	Vibro Corer	VC	07:18	42°20,846' N	9° 09,013' W	138
15683-3	ME844/530	24.05.11	Vibro Corer	VC	07:58	42°20,845' N	9° 09,014' W	138
15684-2	ME844/531	24.05.11	Vibro Corer	VC	09:16	42°27,719' N	9° 06,545' W	98
15685-3	ME844/534	24.05.11	Vibro Corer	VC	12:22	42°28,303' N	9° 10,501' W	114
15686-3	ME844/533	24.05.11	Vibro Corer	VC	11:19	42°28,851' N	9° 10,496' W	111
15687-4	ME844/532	24.05.11	Vibro Corer	VC	10:30	42°29,302' N	9° 10,503' W	101

5.6.3 Preliminary Results

The sediment cores are widely distributed over in the entire working area and cover, thus, nearly all attractive localities which should provide important information on sediment transport, distribution and depositional processes.

5.6.3.1 The Western Interior Basin

Most cores taken in the low-gradient basin show the same stratigraphic succession with little variations. The Holocene is characterized by pale sediments of minor thickness (few tens of centimeters only) with a sharp boundary at the base. The Late Pleistocene unit is much darker and homogenous due to a high grade of bioturbation. Commonly, Heinrich 1a can nicely be recognized in 1 to 2 m core depth since it appears as a defined, sharply bounded brown layer. All of these cores seem to go stratigraphically back into MIS 3 or maybe MIS 4. As an exception, one core seems to go back into MIS 5 (!), according to the pale sediment colours in its deepest section. The only differences between these cores are sedimentation rates which seem to vary slightly during different time intervals. The current control on deposition, as it is frequently found in the acoustic profiles (see Chapter 5.2) cannot deduce from these sediments at a first glance.

The newly discovered channel system in the Northwest of the working area (cp. Fig. 5.1) seems to represent a sharp boundary in the oceanographic and sedimentary basin system. Whilst the deposits south of the channel display the "normal" hemipelagic (slightly contouritic?) basin fill, nearly no such deposits are found on the rapidly rising seafloor north of the channel. Rather, mass-transport deposits predominate here, mainly in the form of debritic slump material. The thalweg of the channel is sandy (and thus difficult to core), and these clean sands are (at least partly) composed of a spectacular mixture of black glauconite shelf material and white benthic foraminiferal material. Thus, a long-distance transport of sand into the basin is documented.

5.6.3.2 The Galician Continental Slope

The morphology of the slope off Galicia shows a highly diverse structuring (see Chapter 5.2). According to the expected wide spectrum of sediment transport, sorting and depositional processes, the sediment cores record a large variety of sedimentary facies. Cores from normal stratified deposits, for instance from local basins and topographic terraces, commonly contain the same undisturbed stratigraphic succession as we found as typical basin succession.

Inside the gullies, which are expected to serve as conduits for sediments which cross the shelf break, the sedimentary facies are much more diverse with sandy intercalations and partly mass-transported deposits. Nevertheless, each of these gullies seems to have its own dynamics concerning the material transported, the mode of downslope transport and the time of activity. The gully heads seem to be rather sandy and coring was less successful than expected. However with the great core coverage of three individual and independent gullies as well as of the major channel system in the North performed during this cruise, we will be able to reconstruct the role of the gullies in each part of the study area with regard to sediment export pathways from the shelf into the deeper basin.

Sediment cores taken from the contourite body, as a very remarkable feature in the middle of the working area, suggest again the same hemipelagic succession as found in the basin. Therefore, it is not obvious at what time a contouritic regime has lead to the accumulation of this prominent feature. The moat contains partly slumped material and we obtained only a few pieces of real rock material from the neighbouring steeply elevating mount. Both of these findings clearly indicate how intensive the currents interact with this obstacle.

5.6.3.3 The Galician Continental Shelf

Cores from the shelf show the expected large variety of sedimentary facies. On the outer shelf, fine sands dominate and contain the well known high amount of glauconite. The sediment "waves" in the middle part of the working area seem to be relict features, not modern sand waves, which are slightly and partly draped by a young sediment cover only. In mid-shelf position, a number of newly discovered locally confined depocenters have been cored with the Vibrocorer but detailed information is not yet available since these cores have not been opened on board. Cores from the mid-shelf mudbelt are, as expected, very homogenous and fine grained and show often a fining-upward trend.

Detailed core descriptions and physical properties

LEGEND:

Lithology

- Sediment loss
- Clay
  - Silty clay
- Mud
  - Silty mud
  - Sandy mud
- Silt
  - Clayey silt
  - Muddy silt
  - Sandy silt
- Sand
  - Clayey sand
  - Muddy sand
  - Silty sand
  - Gravelly sand
- Gravel
  - Shell-fragment gravel
  - Shell-fragment and siliceous gravel
  - Sandy matrix
  - Muddy matrix
- Overconsolidated deposits / palaeosol
- Cemented clasts / debris

Structures

- Sharp boundary
- Faint / gradual boundary
- Angled / deformed boundary
- Bioturbated boundary
- S Weakly bioturbated
- SS Moderately bioturbated
- SSS Strongly bioturbated
- Fining-upwards
- Quartz grains
- Rock / rock fragment
- Concretion / zementation
- Glaucony
- Mud lens / mud clast
- Sand lens
- Slump structure
- Water escape structure
- Ripple bedding
- Laminated bedding
- Single prominent burrow
- Gastropod / fragment
- Prominent bivalve shell / fragment
- Complete bivalve
- Mollusc shell / fragment
- Scaphopod / fragment
- Coral
- Echinoderm fragments
- Bryozoan
- Serpulid
- Pteropod
- Foraminifers
- Root / plant debris
- Organic / monosulfide spot

Shell fragm. gravel

Abundant dispersed shell fragms.

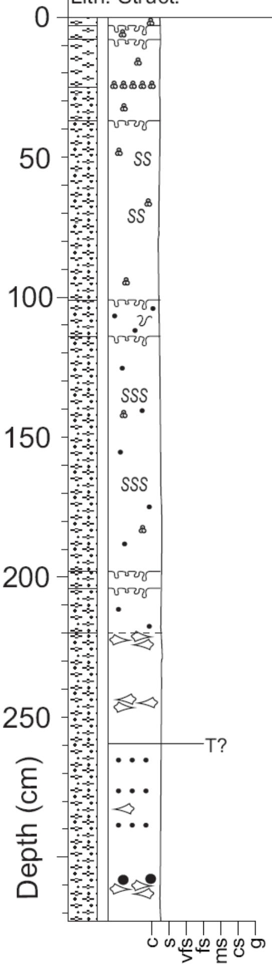
Dispersed shell fragms.

Very abundant dispersed shell fragms.

GeoB 15606-3$_{GC}$

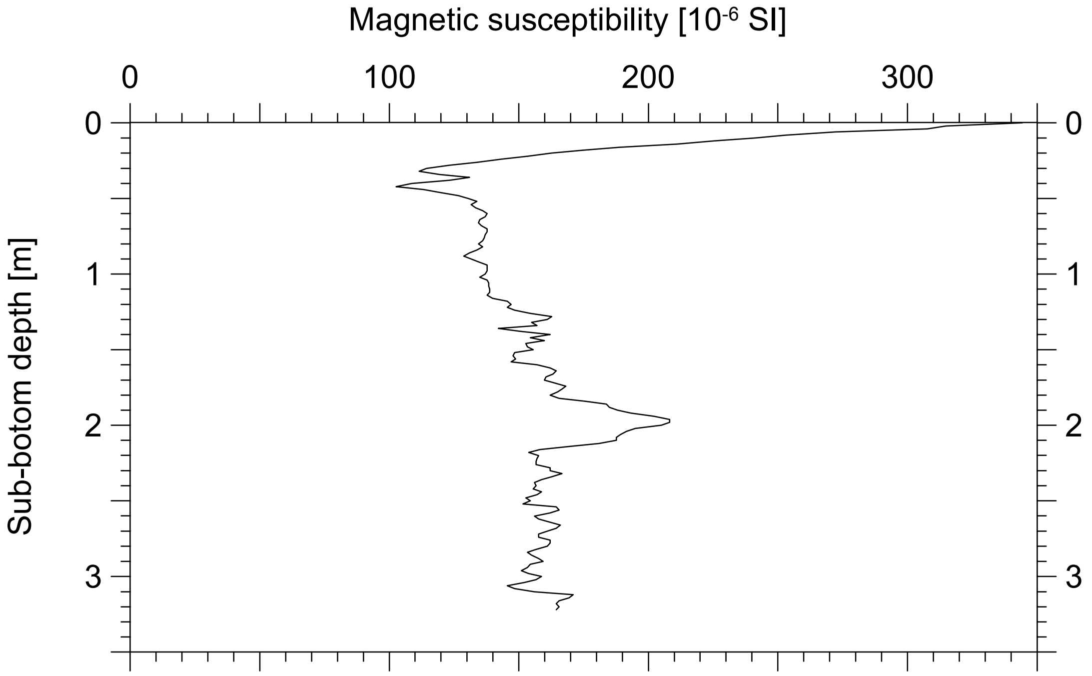
Date: 04.05.11 Pos.: 42°26.21'N 09°38.21'W
Water depth: 1655 m Core length: 323 cm

Lith. Struct. Comments



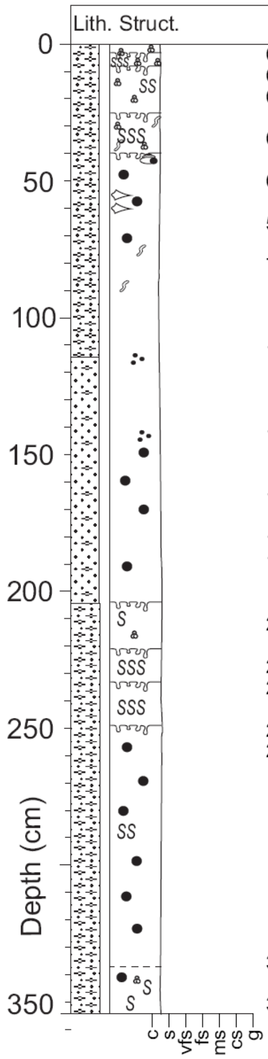
000-003 cm:	2.5Y4/2, olive brown, very soft, foraminifer-bearing mud, bioturbated lower boundary
003-008 cm:	2.5Y5/2, greyish brown, foraminifer-bearing mud, moderately bioturbated lower boundary
008-025 cm:	2.5Y5/2, greyish brown (but less dark than 003-008 cm) foraminifer-bearing mud; enrichment of foraminifers from 023.5-025 cm
025-037 cm:	2.5Y5/1, gray, very fine sandy mud, contains some foraminifers, lower boundary bioturbated by Zoophycos {section boundary at 032 cm}
037-101 cm:	2.5Y4/1, dark gray (darkening towards base of unit), very fine sandy mud, moderately bioturbated by Zoophycos down to 087 cm, some foraminifers, bioturbated lower boundary
101-114 cm:	2.5Y4/1, dark gray (slightly darker than overlying unit), very fine sandy mud, lens of chrondrites bioturbation at 105-108 cm, disperse black spots (organic matter)
114-198 cm:	2.5Y4/1, dark gray, very fine sandy mud, few foraminifers and planolites, black spots (organic matter, mono-sulfide spots?), heavily bioturbated
198-204 cm:	10Y4/1, dark greenish gray, fine sandy mud with higher proportions of very fine sand and fine sand, bioturbated lower boundary
204-220 cm:	2.5Y4/1, dark gray (slightly more brownish) very fine sandy mud, very gradual boundary unit below, black organic spots
220-323 cm:	2.5Y4/1, dark gray very fine sandy mud, low amount of sand, Pteropods dispersed as well as enriched in 2 lenses (~220 and 248 cm), black organic spots, moderately bioturbated 259-260 cm: clean fine sand layer (Turbidite?) 266 cm: larger black stains 276 cm: larger black stains 289 cm: larger black stains 310 cm: 2.5 cm Ø blackish stained spots 312 cm: another Pteropod lens

GeoB 15606-3	Date: 04.05.11 Pos: 42°26,21' N 09°38,21' W Water Depth: 1655 m Core Length: 323 cm



GeoB 15607-3$_{GC}$

Date: 04.05.11 Pos.: 42°28.53'N 09°39.39'W
Water depth: 1883 m Core length: 354 cm



Comments

000-003 cm: 2.5Y4/4, olive brown, foraminifera-bearing mud, bioturbated lower boundary
003-008 cm: 2.5Y5/2, greyish brown foraminifera-bearing mud, highly bioturbated, bioturbated lower boundary
008-025 cm: 2.5Y5/1, gray very fine sandy mud with moderate amounts of foraminifers and moderate bioturbation (planolites)
025-040 cm: 2.5Y4/1, dark gray very fine sandy mud with higher amount of sands than the upper interval and moderate amounts of foraminifers, strongly bioturbated (zoophycos)
040-204 cm: 2.5Y5/1, gray very fine sandy mud, moderately bioturbated (zoophycos) with very abundant organic spots, gastropods at 41 cm depth,
54-64 cm: high concentrations of pteropods, higher grain size (with higher amount of sand) in bioturbated spots,
76+89 cm: bioturbated layers,

115 cm: turbiditic fine sand with glauconite

143-146 cm: turbiditic fine sand with glauconite

167+168 cm: turbiditic layers with fine sands

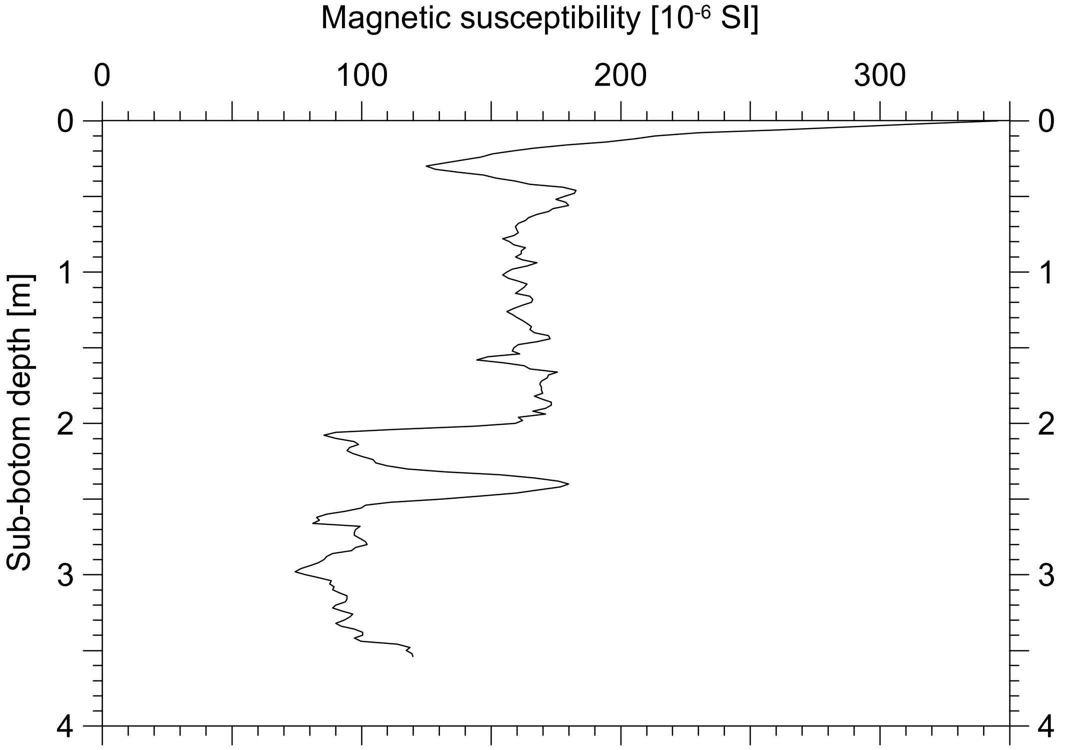
172 cm: turbiditic layers with fine sands
184-185 cm: turbiditic layers with fine sands

204-221 cm: 2.5Y4/1, dark gray fine sandy mud with high amounts of sands, moderate amounts of sands, moderate amounts of foraminifers, weakly bioturbated (zoophycos)
221-233 cm: 2.5Y6/1, gray mud, strongly bioturbated (zoophycos)
233-249 cm: 2.5Y5/1, dark gray mud, strongly bioturbated and increasing downward

249-337 cm: 2.5Y6/1, gray mud moderately bioturbated (planolites), sparse organic spots
253 cm: zoophycos, moderate amounts of foraminifers

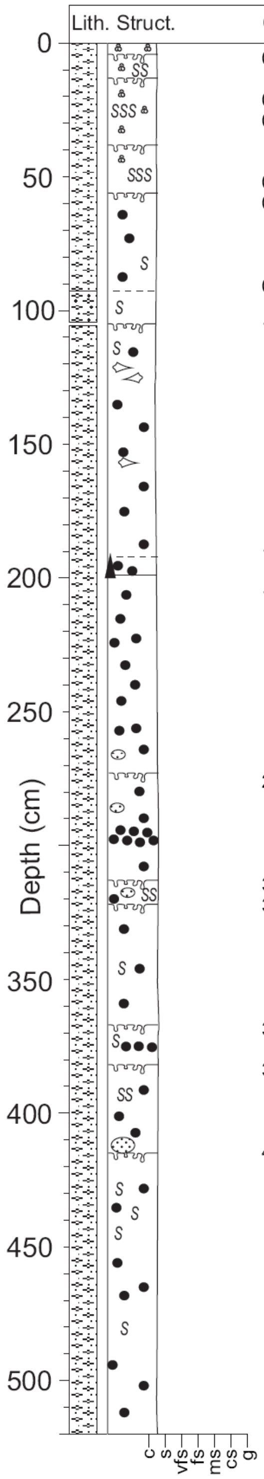
337-347 cm: 2.5Y5/1, gray very fine sandy mud with isolated organic spots with abundant foraminifers, weakly bioturbated abundant foraminifers in this interval
347-354 cm: 10Y5/1, greenish gray mud, weakly bioturbated

GeoB 15607-2	Date: 04.05.11 Pos: 42°28,53' N 09°39,39' W Water Depth: 1883 m Core Length: 354 cm



GeoB 15609-3$_{GC}$

Date: 05.05.11 Pos.: 42°24.65'N 09°47.35'W
Water depth: 518 m Core length: 1935 cm



Comments

000-004 cm: 2.5Y4/3, olive brown, soft, foraminifer-bearing mud bioturbated and progressive lower boundary

004-013 cm: 2.5Y5/2, greyish brown foraminifer-bearing mud moderately bioturbated (planolites?)

013-038 cm: 2.5Y5/1, gray muds with abundant foraminifers, strongly bioturbated, increasing to the top
013-022 cm: chrondrites
022-038 cm: zoophycos

038-056 cm: 10Y4/1, dark greenish gray mud with moderate amounts of foraminifers, pervasive strong bioturbation

056-093 cm: 10Y5/1, greenish gray mud, moderate bioturbation (zoophycos), sparse organic spots

093-105 cm: 10Y4/1, dark greenish gray fine sandy mud with moderate bioturbation

105-192 cm: 10Y4/1, dark greenish gray mud with moderate bioturbation, frequent organic spots, particularly at the bottom of the unit,
121-124 cm: pteropod layer
158 cm: pteropod layer

192-199 cm: 10Y4/1, dark greenish gray fine sandy mud, with a finning upward trend, high amount of sands, two layers enriched in sands (192-195 cm and 198-199 cm)

199-273 cm: 10Y4/1, dark greenish gray mud, moderate bioturbation with widespread organic spots

273-313 cm: 4/56Y, dark greenish gray mud with sandy lenses (at 286 cm) and spots, frequent organic spots with increasing concentration at several levels (292-300 cm), moderate to strong bioturbation (increasing downward)

313-322 cm: 5/56Y, greenish gray muds with lenses enriched in sands, moderate bioturbation and organic spots

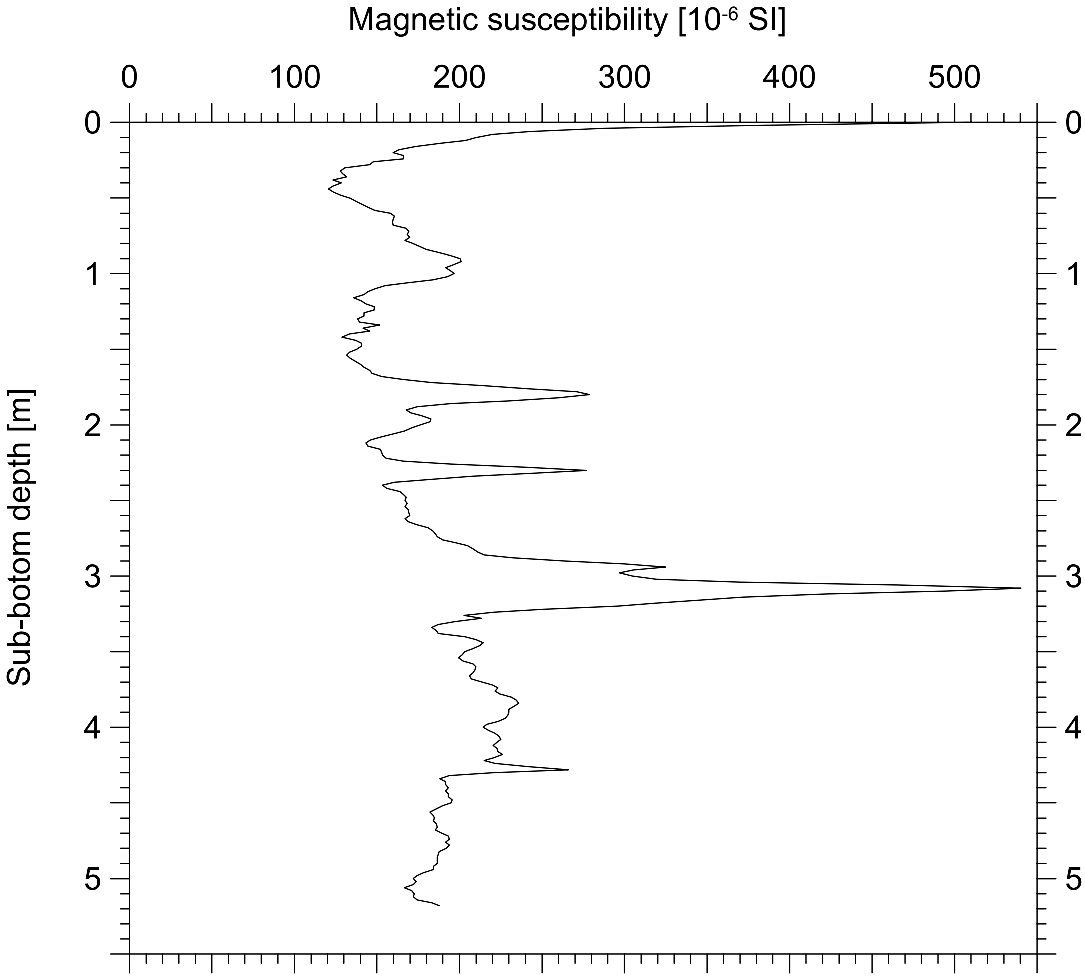
322-367 cm: 4/10Y, dark greenish gray mud with weak bioturbation and frequent organic spots

367-382 cm: 4/10Y, dark greenish gray (slightly darker than the upper interval) muds with bioturbation and increasing amounts of organic spots at 372-374 cm

382-415 cm: 2.5Y4/1, dark gray muds with moderate bioturbation and organic spots, sandy patch near the lower boundary

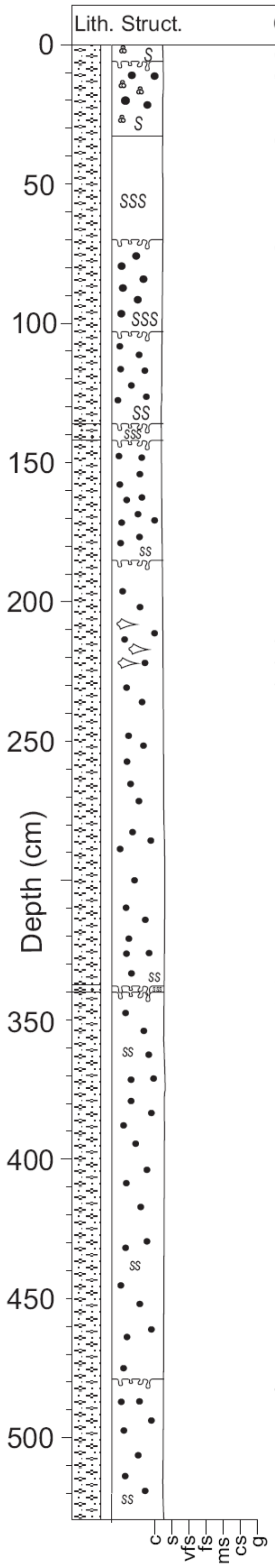
415-518 cm: 5/10Y, greenish gray mud with sparse bioturbation (planolites at 484-500 cm) and frequent organic spots

GeoB 15609-3	Date: 05.05.11 Pos: 42°24,65' N 09°47,35' W Water Depth: 1935 m Core Length: 518 cm



GeoB 15610-1$_{GC}$

Date: 05.05.11 Pos.: 42°23.12'N 09°52.26'W
Water depth: 2214 m Core length: 527 cm



Comments

000-006 cm: 2.5Y4/3, olive brown soft foraminifer-bearing mud with bioturbation
006-033 cm: 2.5Y6/1, gray foraminifer-bearing mud with weak bioturbation (planolites) and organic matter spots

033-070 cm: 3/10Y, very dark greenish gray mud, strongly bioturbated (zoophycus)

070-103 cm: 4/56Y, dark greenish gray mud with frequent organic matter spots and strongly bioturbated at the top

103-136 cm: 5/10Y, greenish gray mud with weak to moderate bioturbation, some organic matter spots

136-142 cm: 2.5Y4/2, dark greyish brown, very fine sandy mud strongly bioturbated (chrondrites at the base)
142-185 cm: 4/56Y, dark greenish gray mud, moderately bioturbated with abundant organic matter spots

185-338 cm: 4/10Y, dark greenish gray mud with widespread organic matter spots and moderately bioturbated,

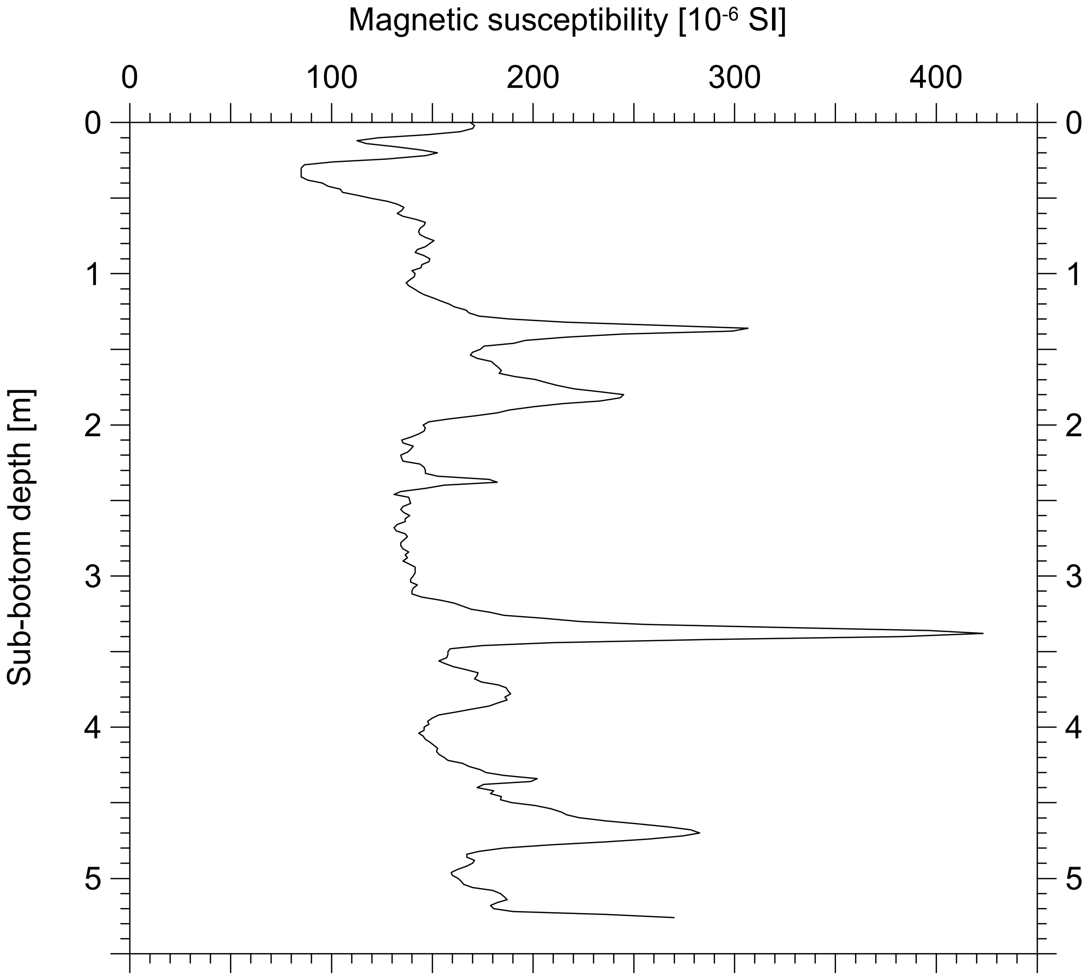
208 cm patches enriched in pteropodes
217-219 cm patches enriched in pteropodes
222-223 cm patches enriched in pteropodes

338-340 cm: 2.5Y4/2, dark greyish brown very fine sandy mud strongly bioturbated
340-479 cm: 4/10Y, dark greenish gray muds with abundant organic matter spots and moderate to high bioturbation

479-527 cm: 4/10Y, dark greenish gray muds slightly brownish and moderate bioturbation and abundant organic matter spots at the upper half of the interval

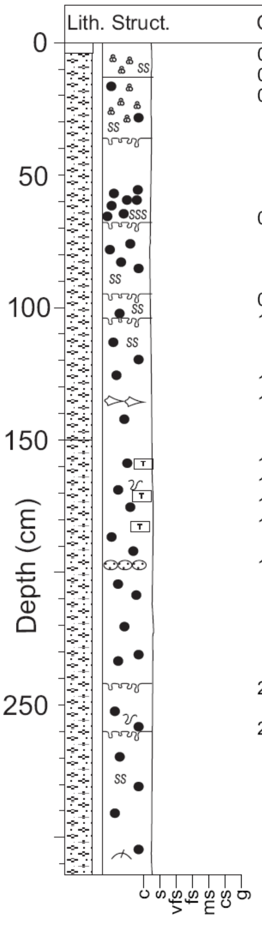
GeoB 15610-1

Date: 05.05.11 Pos: 42°23,12' N 09°52,26' W
Water Depth: 2214 m Core Length: 527 cm



GeoB 15612-2$_{GC}$

Date: 05.05.11 Pos.: 42°31.88'N 09°53.09'W
Water depth: 2359 m Core length: 314 cm



Comments

004-013 cm: 2.5Y4/3, olive brown, soft, foraminifer mud with moderate bioturbation (planolites)
013-022 cm: 2.5Y6/1, gray foraminifer-bearing mud with moderate bioturbation and organic matter spots
022-068 cm: 4/10Y, dark greenish gray mud with strong bioturbation (zoophycos) and organic matter spots toward the base of the interval

068-095 cm: 4/56Y, dark greenish gray mud with low amounts of sandy-sized material, moderately bioturbated (chrondrites at the top and planolites), spots of organic matter (more frequent between 82-87 cm), 91 cm: sa

095-114 cm: 4/10Y, dark greenish gray mud and moderate bioturbation and organic matter spots
114-242 cm: 4/56Y, dark greenish gray mud with moderate bioturbation (planolites near the top of the interval), pervasive occurrence of spots of organic matter

130- 131 cm: turbiditic sandy layer
136+140 cm: levels enriched in pteropods

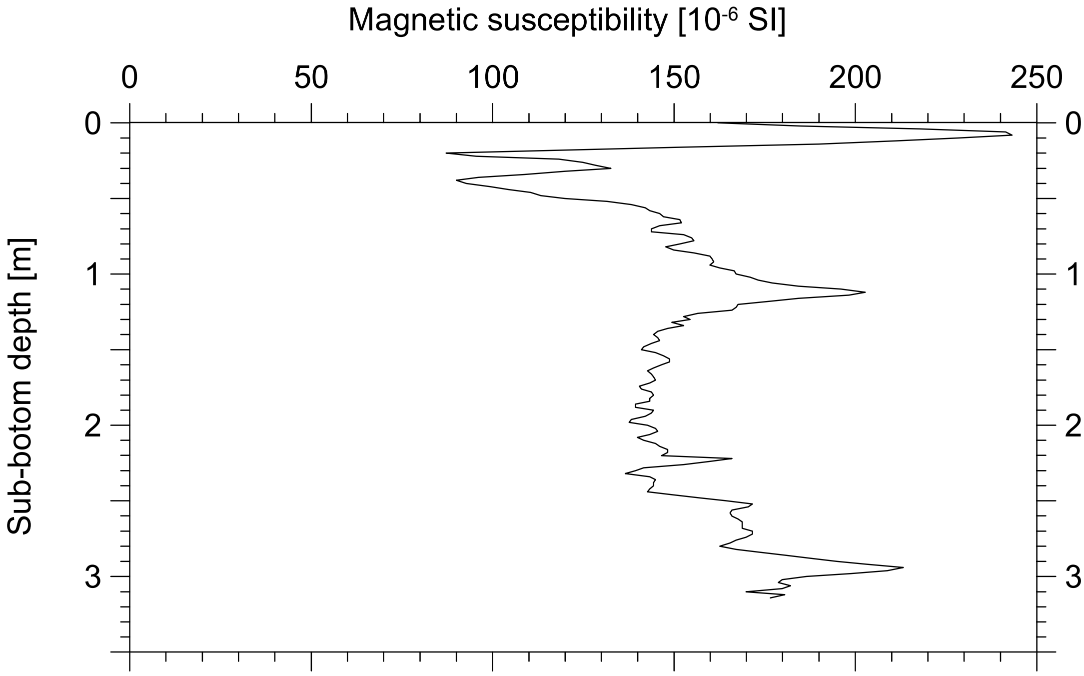
159-160 cm: turbiditic sandy layer
167-169 cm: zoophycos
172-173 cm: turbiditic sandy layer
183-184 cm: turbiditic sandy layer

198-218 cm: increased amounts of sands in the interval, appearing as lenses or spots

242-260 cm: 2.5Y4/2, dark greyish brown mud with organic matter spots and weak bioturbation (zoophycos at 254 cm)

260-314 cm: 4/10Y, dark greenish gray mud with moderate bioturbation and spots of organic matter, 298 cm: carbonate fragment

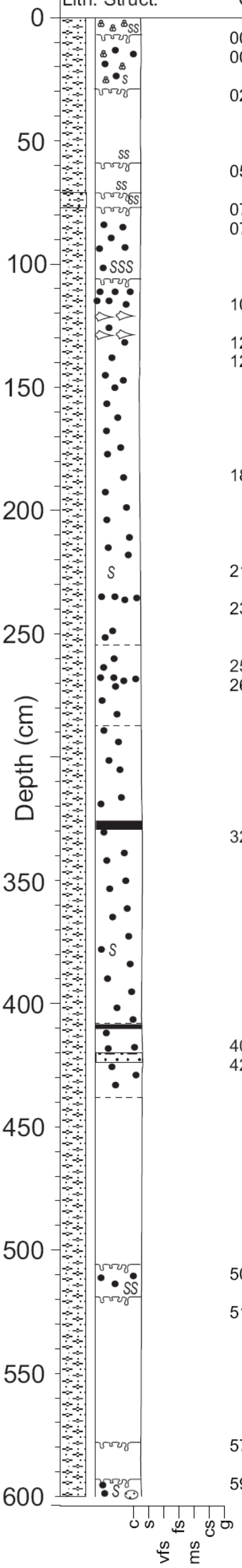
GeoB 15612-2	Date: 05.05.11 Pos: 42°31,88' N 09°53,09' W Water Depth: 2359 m Core Length: 314 cm



GeoB 15613-1$_{GC}$

Date: 07.05.11 Pos.: 42°27.05'N 10°03.00'W
Water depth: 2639 m Core length: 874 cm

Lith. Struct. Comments



000-007 cm: 2.5Y5/4, light olive brown, soft, foraminifer-bearing mud with moderate bioturbation
007-029 cm: 2.5Y6/1, gray foraminifer-bearing mud with weak bioturbation and organic matter spots

029-059 cm: 5/10Y, greenish gray mud, moderately bioturbated (zoophycos, planolites)

059-071 cm: 4/10Y, dark greenish gray mud, moderate bioturbation (zoophycos)

071-077 cm: 2.5Y4/1, dark gray, very fine sandy mud with moderate bioturbation
077-106 cm: 4/10Y, dark greenish gray, highly bioturbated mud with spots of organic matter, 98-99 cm: lens of very fine sand

106-506 cm: 4/10Y, dark greenish gray mud with abundant organic matter spots and weak bioturbated, although is higher to the top (106-115 cm), (zoophycos, planolites)
121-123 cm: two lenses enriched in pteropods
127-130 cm: two lenses enriched in pteropods

181-186 cm: level enriched in very fine sands

218-219 cm: level enriched in very fine sands

236-237 cm: layers enriched in organic matter

253-288 cm: lighter band with no appreciable granulometric change
267-269 cm: layers enriched in organic matter

328-330 cm: darker band with no appreciable granulometric change

408-438 cm: darker interval with no appreciable granulometric change
422-424 cm: level enriched in very fine sands

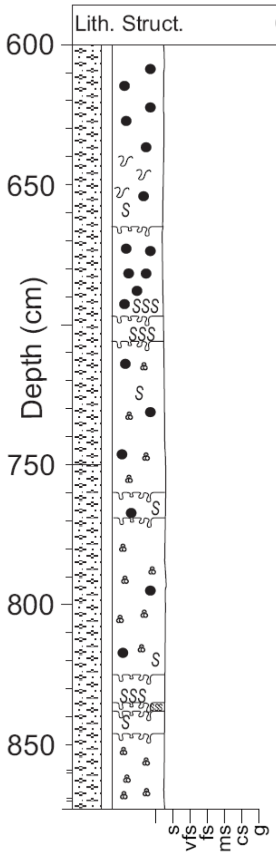
506-519 cm: 3/10Y, very dark greenish gray mud with abundant organic matter spots and moderate bioturbation
519-578 cm: 5/10Y, greenish gray mud

578-593 cm: 5/10Y, greenish gray mud

593-665 cm: 4/10Y, dark greenish gray mud with moderate bioturbation (zoophycos between 640-660 cm) organic matter spots and weak bioturbation
603-604 cm: sandy patch

GeoB 15613-1$_{GC}$

Date: 07.05.11 Pos.: 42°27.05'N 10°03.00'W
Water depth: 2639 m Core length: 874 cm



Comments

665-697 cm: 5/10Y, greenish gray mud with large organic matter spots and strong bioturbation

697-705 cm: 4/10Y, dark greenish gray mud, strongly bioturbated

705-760 cm: 6/10Y, greenish gray foraminifer-bearing mud with sparse organic matter spots (similar to a coccolithophore ooze), weak bioturbation

760-769 cm: 4/10Y, dark greenish gray mud with organic matter spots and weak bioturbation

769-825 cm: 5/10Y, greenish gray foraminifer-bearing mud (similar to a coccolithophore ooze), weak bioturbation and organic matter spots

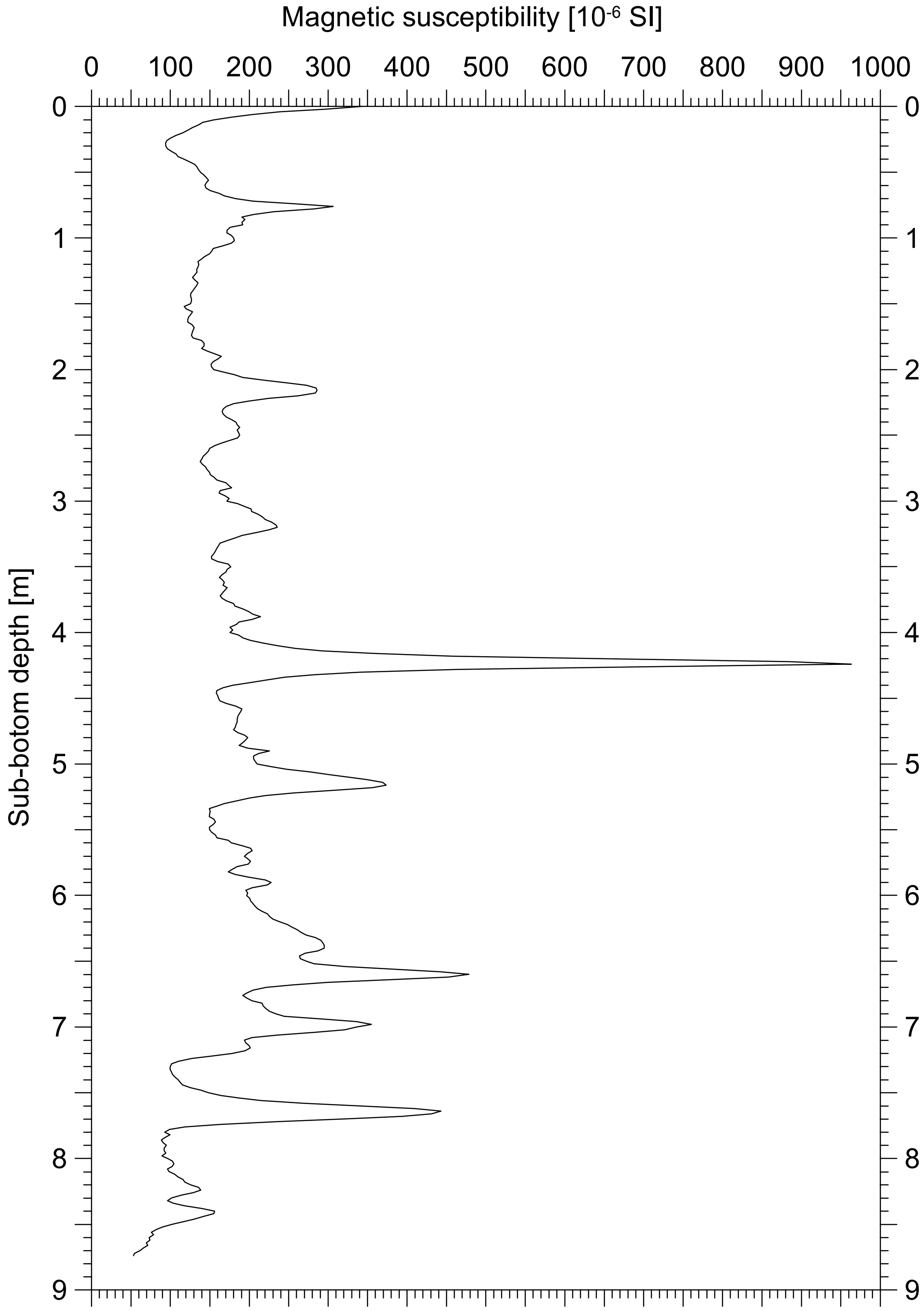
825-835 cm: 6/10Y, greenish gray mud with strong bioturbation

835-838 cm: 4/10Y, dark greenish gray very fine sandy mud strong bioturbation

838-846 cm: 4/10Y, dark greenish gray mud with weak bioturbation

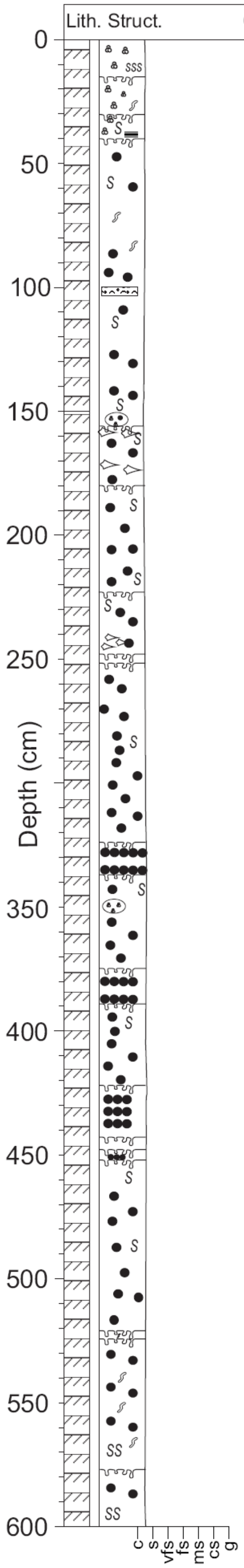
846-874 cm: 7/10Y, light greenish gray muds some foraminifers (similar to a coccolithophore ooze)

GeoB 15613-1	Date: 07.05.11 Pos: 42°27,05' N 10°03,00' W Water Depth: 2639 m Core Length: 874 cm



GeoB 15615-2$_{GC}$

Date: 10.05.11 Pos.: 42°22.225'N 09°42.703'W
Water depth: 1708 m Core length: 695 cm



Comments

000-015 cm: 2.5Y5/4, light olive brown, soft, foraminifer-bearing mud, strongly bioturbation

015-025 cm: 2.5Y5/1, gray foraminifer-bearing mud weakly bioturbated (planolites)
025-040 cm: 2.5Y6/1, gray foraminifer-bearing mud weakly bioturbated (laminated)

040-100 cm: 4/10Y, dark greenish gray mud, weakly bioturbated (zoophycos), organic matter spots in the 100 cm interval

100-156 cm: 4/10Y, dark greenish gray mud weakly bioturbated and abundant organic matter spots, sandy layer at 103 cm, patch of foraminifers and organic matter at 152 cm

156-180 cm: 4/10Y, dark greenish gray mud, weakly bioturbated, sparse organic matter spots
157-159 cm: pteropods patch
174-177 cm: pteropods patch

180-223 cm: 5/10Y, gray mud, weakly bioturbated, sparse organic matter spots

223-248 cm: 4/10Y, dark greenish gray mud, weakly bioturbated with abundant organic matter spots pteropd level at 239-242 cm
248-252 cm: 5/10Y, dark greenish gray mud with increased amounts of very fine sands
252-324 cm: 5/10Y, greenish gray mud, weakly bioturbated and with organic matter spots 273-274 cm: patch of organic matter and foraminifers

324-337 cm: 4/10Y, dark greenish gray with abundant organic matter spots
337-375 cm: 5/10Y, greenish gray mud, weakly bioturbated and with organic matter spots 348-350 cm: patch of sandy-sized foraminifers

375-389 cm: 4/10Y, dark greenish gray with abundant organic matter bands

389-422 cm: 5/10Y, greenish gray mud, weakly bioturbated and with organic matter spots

422-443 cm: 4/10Y, dark greenish gray with abundant organic matter bands

443-448 cm: 5/10Y, greenish gray mud
448-452 cm: 4/10Y, dark greenish gray with abundant organic matter bands
452-521 cm: 5/10Y, greenish gray mud, weakly bioturbated with scarce organic matter spots

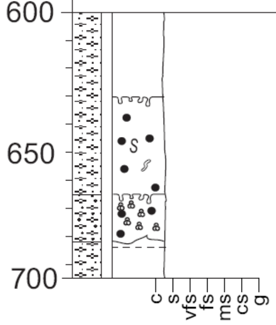
521-524 cm: 5/10Y, greenish gray mud with abundant very fine sand
524-577 cm: 4/10Y, dark greenish gray with moderate bioturbation (zoophycos), organic matter spots

577-630 cm: 5/10Y, greenish gray mud with moderate bioturbation and some patches of organic matter

GeoB 15615-2_{GC}

Date: 10.05.11 Pos.: 42°22.225'N 09°42.703'W
Water depth: 1708 m Core length: 695 cm

Lith. Struct. Comments



630-665 cm: 4/10Y, dark greenish gray mud, weakly bioturbated and some organic spots

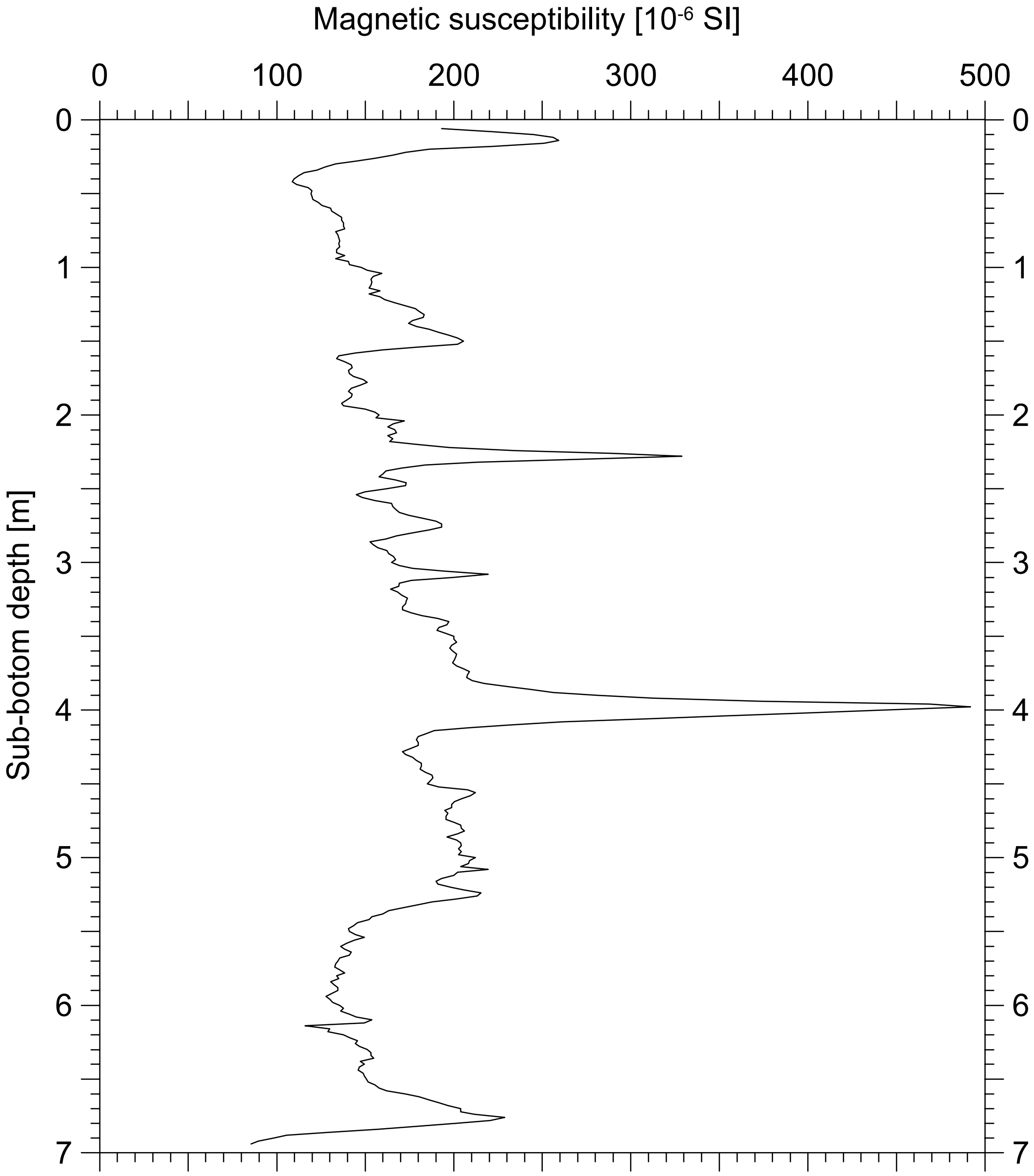
650-658 cm: bioturbation structure filled with very soft mud (with abundant organic matter)

665-682 cm: 2.5Y4/2, dark greenish brown sandy mud with abundant foraminifers, spots of organic matter

682-684 cm: 2.5Y5/2, greyish brown mud
684-695 cm: 4/10Y, dark greenish gray mud

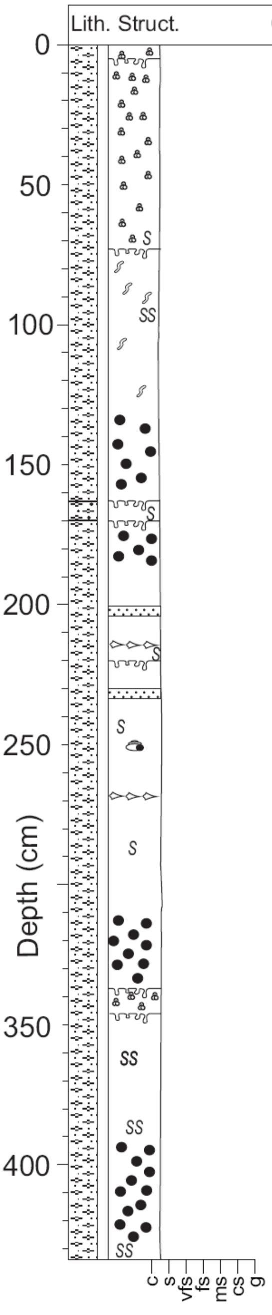
GeoB 15615-2

Date: 10.05.11 Pos: 42°22,22' N 09°42,70' W
Water Depth: 1708 m Core Length: 695 cm



GeoB 15616-2$_{GC}$

Date: 10.05.11 Pos.: 42°22.34'N 09°42.31'W
Water depth: 1794 m Core length: 434 cm



Comments

000-005 cm: 10YR5/3, brown soft foraminifer-bearing mud
005-073 cm: 2.5Y5/2, greyish brown foraminifer-bearing mud weakly bioturbated,

71 cm: lens with high foraminifer abundance
073-163 cm: 4/10Y, dark greenish gray mud, moderately bioturbated (zoophycos abundant between 73 and 127 cm), spots if organic matter between 130 and 163 cm

163-170 cm: 4/10Y, dark greenish gray sandy mud weakly bioturbated
170-220 cm: 4/56Y, dark greenish gray mud weakly bioturbated with abundant organic matter spots toward the upper boundary

201-205 cm: band with increased amount of sands

214-215 cm: level enriched in pteropods
220-337 cm: 4/10Y, dark greenish gray mud, weakly bioturbated
230-234 cm: band with increased amount of sands

250 cm: gastropod 3.5 cm long

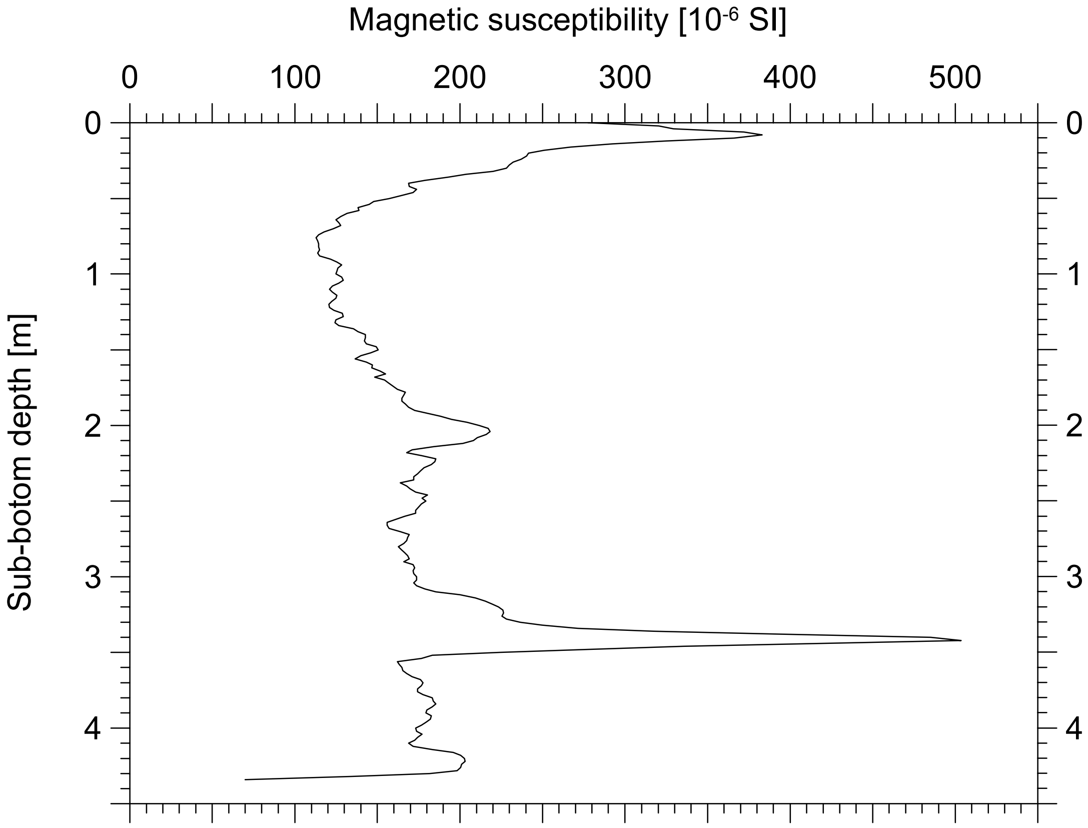
268-269 cm: level enriched in pteropods

311 cm toward the base: high amount if organic matter

337-346 cm: 4/10Y, dark greenish gray mud with high amount of foraminifers
346-434 cm: 4/10Y, dark greenish gray mud, moderately bioturbated

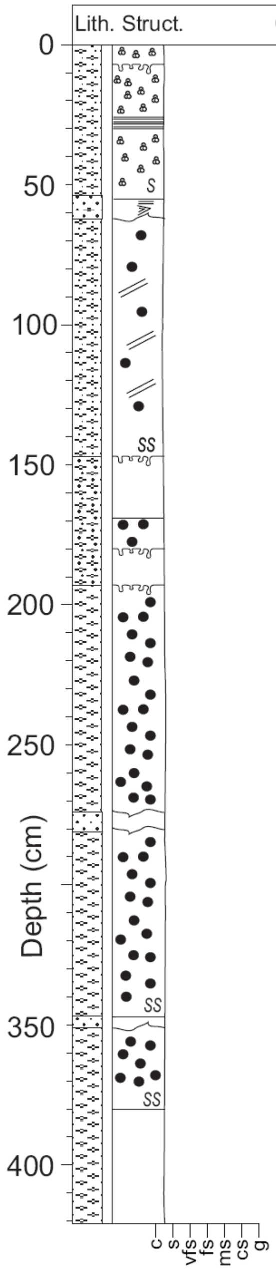
390-434 cm: abundant organic matter spots, particularly toward the base

GeoB 15616-2	Date: 10.05.11 Pos: 42°22,34' N 09°42,31' W Water Depth: 1794 m Core Length: 434 cm



GeoB 15617-2$_{GC}$

Date: 10.05.11 Pos.: 42°22.49'N 09°41.72'W
Water depth: 1859 m Core length: 421 cm



Comments

000-007 cm: 2.5Y5/3, light olive brown soft foraminifer-bearing mud
007-055 cm: 2.5Y5/2, greyish brown foraminifer-bearing mud, weakly bioturbated (mainly planolites),

26-30 cm: three brown bands

055-062 cm: 4/10Y, dark greenish gray very fine sands with abundant foraminifers, planar and low-angle cross stratification, dark and light tones in relation with the structures
062-147 cm: 4/10Y, dark greenish gray mud with moderate bioturbation (zoophycos, planolites), scarce organic matter spots

147-169 cm: 4/10Y, dark greenish gray very fine sandy mud

169-180 cm: 2.5Y5/2, greyish brown very fine sandy mud, some organic matter spots

180-193 cm: 4/56Y, dark greenish gray very fine sandy mud

193-274 cm: 4/10Y, dark greenish gray mud with organic matter spots, some patches of very fine sands

274-281 cm: 4/56Y, dark greenish gray very fine sands

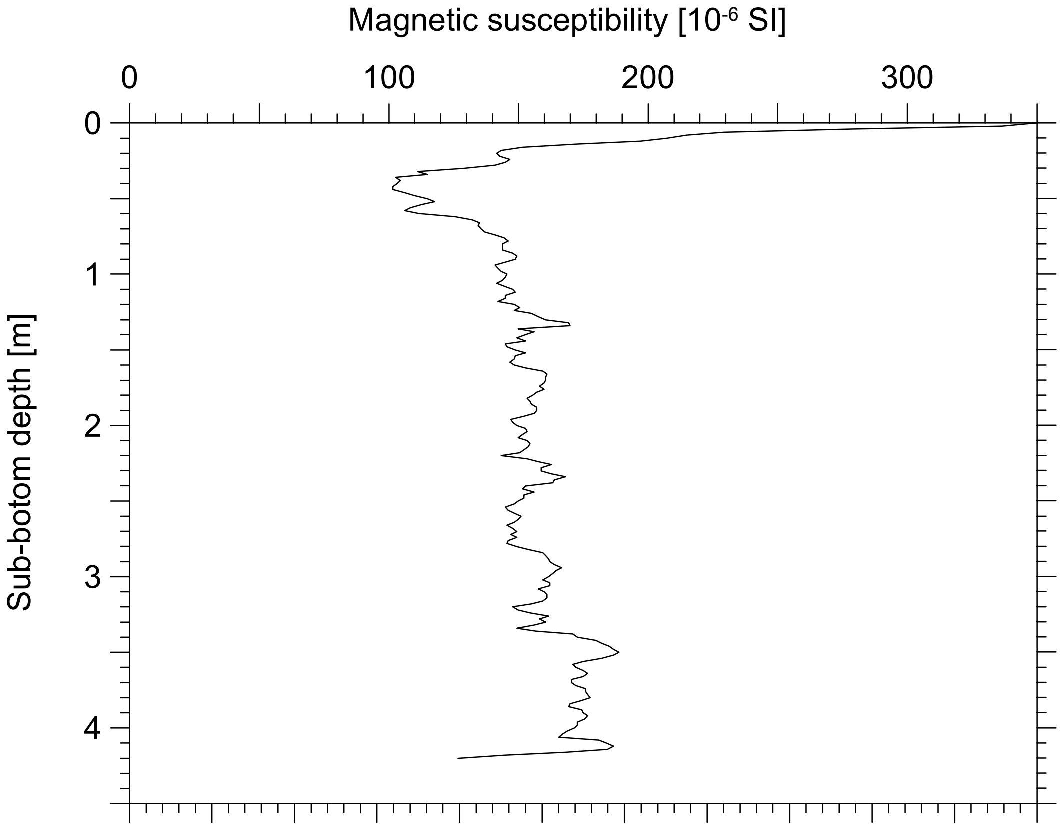
281-347 cm: 4/106Y, dark greenish gray mud with moderate bioturbation and some organic matter spots,

325-335 cm: path of bioturbation

347-351 cm: 4/106Y, dark greenish gray very fine sands, base slightly erosional
351-380 cm: 4/106Y, dark greenish gray mud with moderate bioturbation (planolites) and organic matter spots, some fragments towards the base

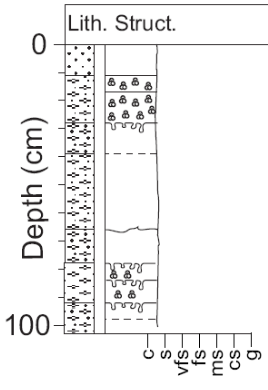
380-421 cm: 4/106Y, dark greenish gray mud with intercalations of very fine sands, distorted sediments in a Slimy-like fashion

GeoB 15617-2	Date: 10.05.11 Pos: 42°22,49' N 09°41,72' W Water Depth: 1859 m Core Length: 421 cm



GeoB 15618-2$_{GC}$

Date: 10./11.05.11 Pos.: 42°38.05'N 09°53.66'W
Water depth: 2000 m Core length: 103 cm



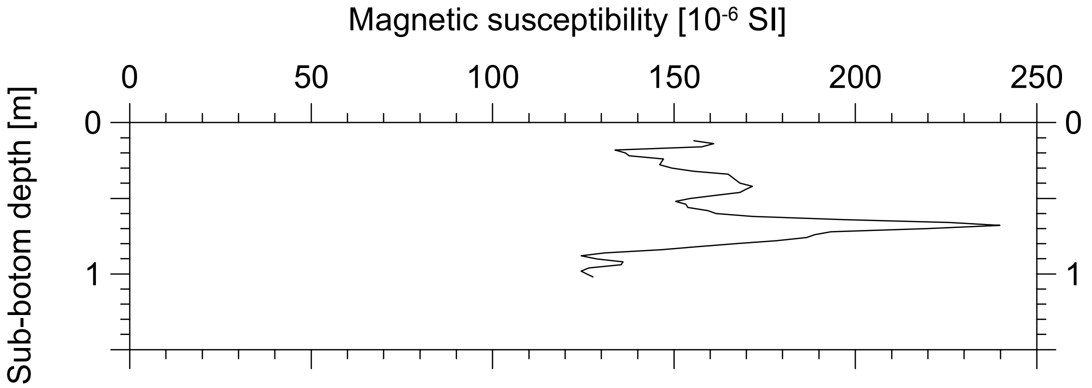
Comments

000-011 cm: 3/10Y, very dark greenish gray fine sand
011-017 cm: 2.5Y5/3, light olive brown soft foraminifer-bearing mud
017-028 cm: 2.5Y6/1, gray foraminifer-bearing mud
028-039 cm: 4/106Y, dark greenish gray very fine sandy mud

039-066 cm: 4/10Y, dark greenish gray mud with some
Sandy lamination at 49-50 cm, 56-57 cm, 60-61 cm

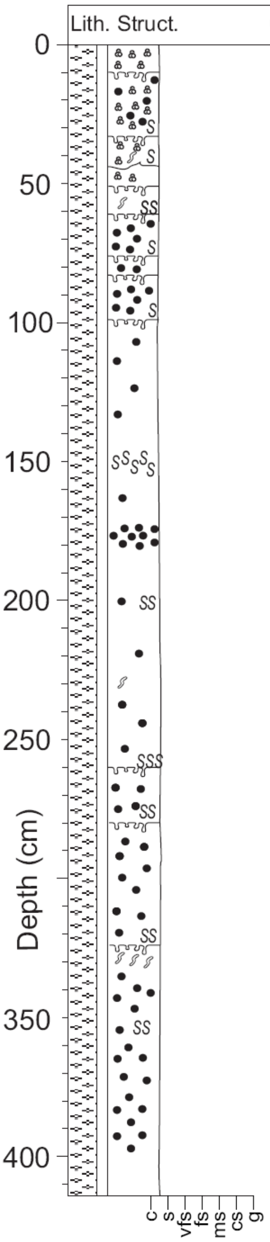
066-078 cm: 4/10Y, dark greenish gray very fine sandy mud
078-084 cm: 2.5Y5/3, light olive brown soft foraminifer-bearing mud
084-092 cm: 2.5Y6/1, gray foraminifer-bearing mud
092-098 cm: 4/10Y, dark greenish gray very fine sandy mud
098-103cm: 4/10Y, dark greenish gray very fine sandy mud

GeoB 15618-3	Date: 11.05.11 Pos: 42°38,05' N 09°53,66' W Water Depth: 2000 m Core Length: 103 cm



GeoB 15619-1$_{GC}$

Date: 11.05.11 Pos.: 42°33.084'N 09°53.210'W
Water depth: 2356 m Core length: 414 cm



Comments

000-010 cm: 2.5Y5/3, light olive brown soft foraminifer-bearing mud
010-033 cm: 2.5Y5/1, gray foraminifer-bearing mud with weak bioturbation and sparse organic matter spots
033-044 cm: 5/10Y, greenish gray mud with some foraminifers, weakly bioturbated (zoophycos)
044-051 cm: 2.5Y7/1, light gray mud with abundant foraminifers, a sandy patch at least 6-7 cm thick with abundant organic matter
051-061 cm: 2.5Y6/1, gray mud with a dark sandy patch with high organic matter content, moderate bioturbation (zoophycos)
061-076 cm: 2.5Y6/1, gray mud (slightly darker than the upper interval), weakly bioturbation with organic matter spots
076-083 cm: 2.5Y6/1, gray mud with some organic matter spots
083-099 cm: 6/10Y, greenish gray mud with moderate bioturbation and organic matter spots
099-260 cm: 5/10Y, greenish gray mud with moderate bioturbation, higher bioturbation at some specific levels:

148-157 cm: strong bioturbation

161 cm: disturbed layer, higher abundance of organic matter spots

172-182 cm: also spots of organic matter do occur in the rest of the unit

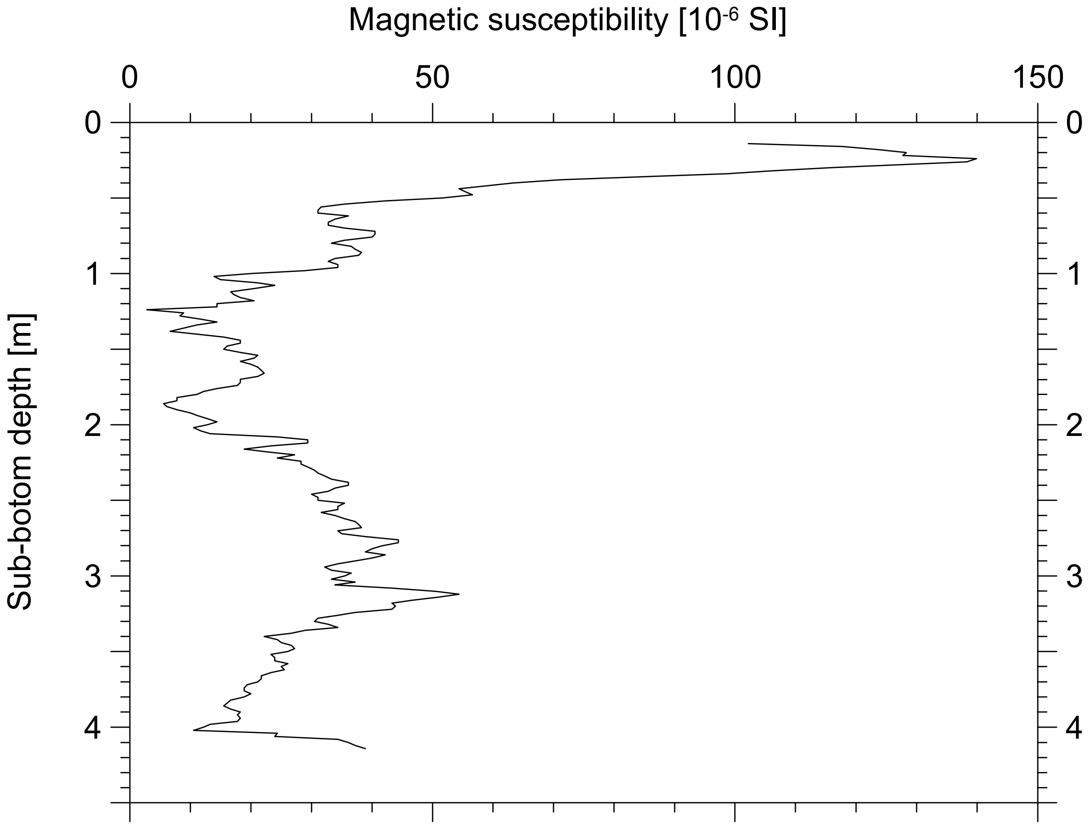
230 cm: zoophycos

Base: strong bioturbation
260-280 cm: 5/10Y, greenish gray mud with moderate bioturbation and scarce organic matter spots, 273-274 cm: two clasts 2 cm long

280-324 cm: 5/56Y, greenish gray mus with moderate bioturbation and organic matter spots, 292 cm: a rounded clast

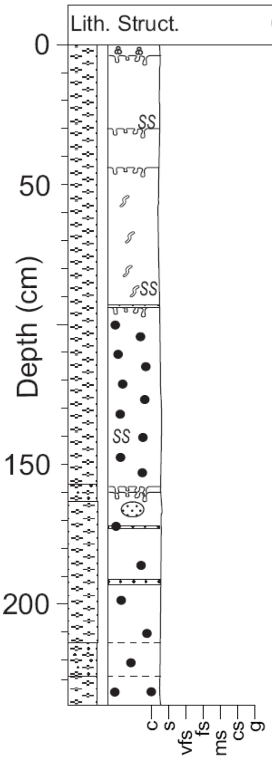
324-414 cm: 6/10Y, greenish gray mud with moderate bioturbation and organic matter spots (large spots), strong bioturbation by zoophycos toward the top of the unit (324-336 cm), 362 Cm: clast 3 cm long

GeoB 15619-1	Date: 11.05.11 Pos: 42°33,08' N 09°53,21' W Water Depth: 2356 m Core Length: 414 cm



GeoB 15620-2 GC

Date: 11.05.11 Pos.: 42°28.66'N 09°35.16'W
Water depth: 1625 m Core length: 236 cm



Comments

000-004 cm: 2.5Y5/2, greyish brown soft foraminifer-bearing mud
004-030 cm: 2.5Y5/1, gray foraminifer-bearing mud, moderately bioturbated

030-046 cm: 2.5Y5/1, gray sandy mud

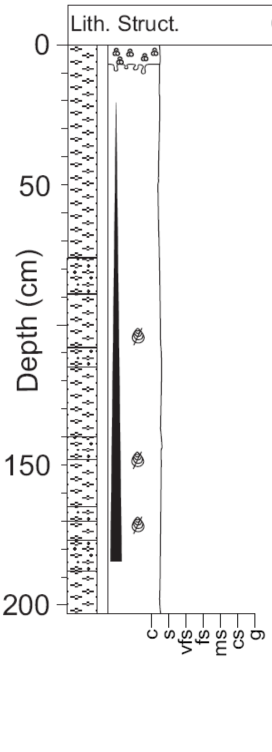
046-094 cm: 3/10Y, very dark greenish gray mud moderately bioturbated (zoophycos),

093-094 cm: sandy layer
094-157 cm: 4/10Y, dark greenish gray mud with organic matter spots and moderate bioturbation (planolites)

157-160 cm: brown very fine sandy mud
160-214 cm: 4/10Y, dark greenish gray mud, moderately bioturbated and organic spots, intercalation of sandy layers at the following levels:
160-168 cm: sandy patch
172-173 cm: sandy layer
192-194 cm: sandy layer
scarce organic matter spots
214-226 cm: 4/10Y, dark greenish gray sandy mud
226-236 cm: 4/10Y, dark greenish gray mud

GeoB 15621-1 GC

Date: 11.05.11 Pos.: 42°27.86'N 09°35.18'W
Water depth: 1740 m Core length: 201 cm



Comments

000-007 cm: brown foraminifer-bearing mud
007-190 cm: DEBRITE, alternance of packages with district
2.5Y6/1, gray
2.5Y5/1, gray
2.5Y4/1, dark gray
GLEY 1 4/10Y, dark greenish gray
GLEY 1 5/10Y, greenish gray
major packages of dark grays embedded in relatively lighter grays. In general, there is an Fining-upward trend, but higher grain sizes tend to be selected with darker sediments

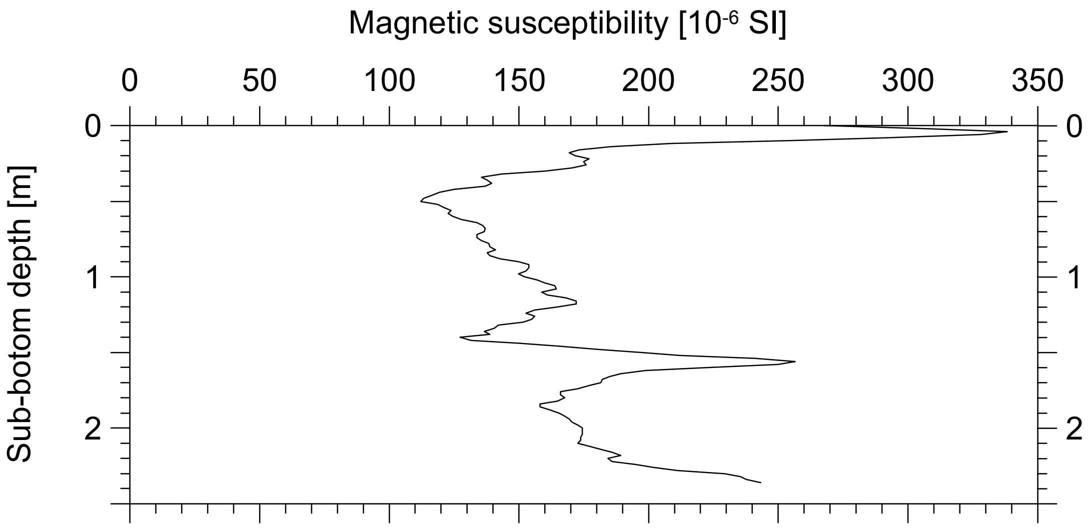
076-089 cm: packages of sandy muds within muddy sediments

104 cm: shell fragment
108-115 cm: packages of sandy muds within muddy sediments

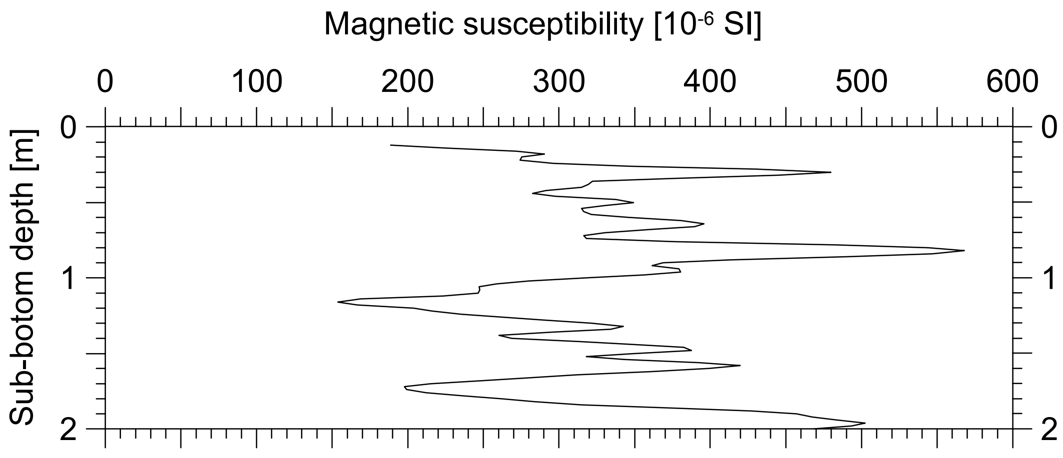
140-145 cm: packages of sandy muds within muddy sediments
148 cm: shell fragment

165-170 cm: packages of sandy muds within muddy sediments
170 cm: shell fragment
177-188 cm: packages of sandy muds within muddy sediments
190-201 cm: 4/10Y, dark greenish gray muds with frequent organic matter spots
201-203 cm: debrites seem to occur again

GeoB 15620-2	Date: 11.05.11 Pos: 42°28,66' N 09°35,16' W Water Depth: 1625 m Core Length: 236 cm

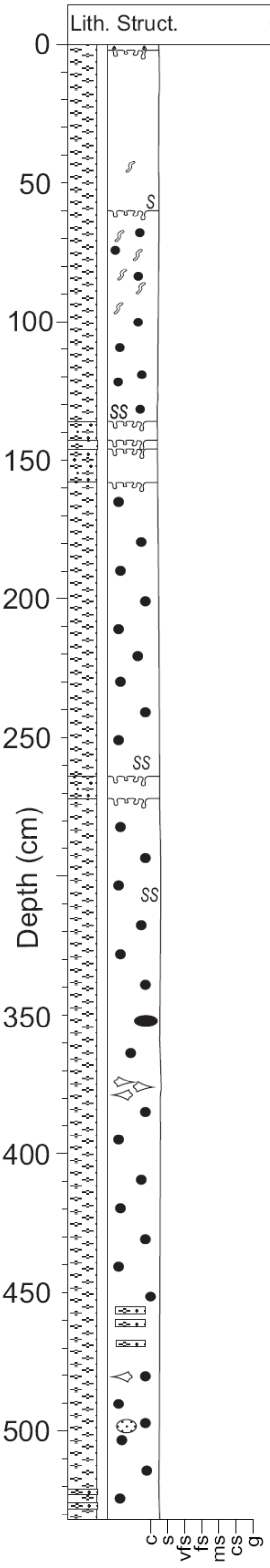


GeoB 15621-1	Date: 11.05.11 Pos: 42°27,86' N 09°35,18' W Water Depth: 1740 m Core Length: 201 cm



GeoB 15623-2$_{GC}$

Date: 11.05.11 Pos.: 42°04.35'N 09°32.65'W
Water depth: 1619 m Core length: 532 cm



Comments

000-002 cm: 2.5Y5/3, light olive brown soft foraminifer-bearing mud
002-060 cm: 2.5Y5/1, gray foraminifer-bearing mud with moderate bioturbation, at 045 cm zoophycos

060-136 cm: 4/10Y, dark greenish gray mud, bioturbated by zoophycos toward the unit upper boundary (up to 100 cm depth), frequent organic matter spots, 121-122 cm: sandy patches

136-143 cm: 4/10Y, dark greenish gray sandy mud
143-146 cm: 4/10Y, dark greenish gray mud
146-158 cm: 4/10Y, dark greenish gray sandy mud
158-264 cm: 4/10Y, dark greenish gray mud with abundant organic matter spots and moderate bioturbation

264-272 cm: 4/10Y, dark greenish gray very fine sandy mud with some browny patches
272-532 cm: 4/10Y, dark greenish gray mud with organic matter spots and morderate bioturbation

352 cm: dark patch

376-379 cm: patch of pteropods

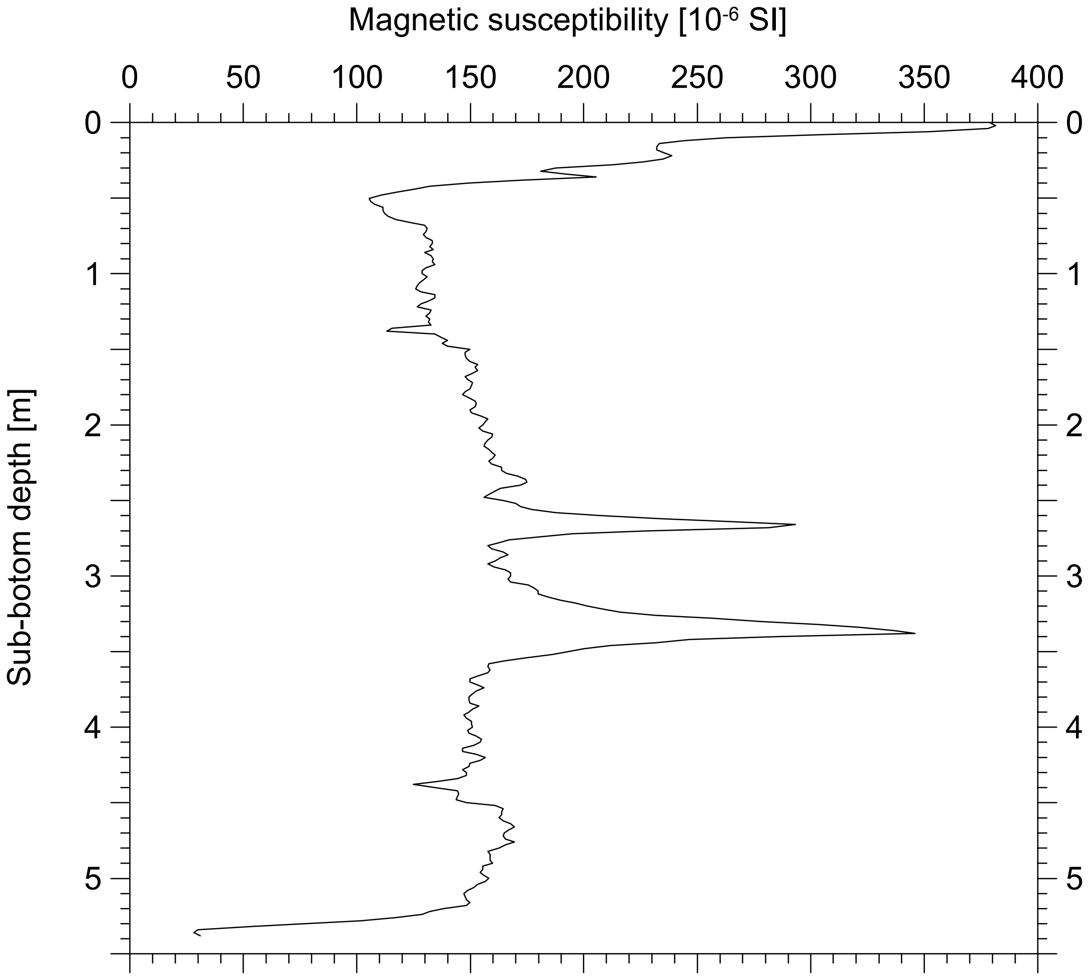
456-457 cm: level of fine sandy mud
460-462 cm: level of fine sandy mud
468-470 cm: level of fine sandy mud

481 cm: patch of pterodos

499 cm: patch of sandy sediments

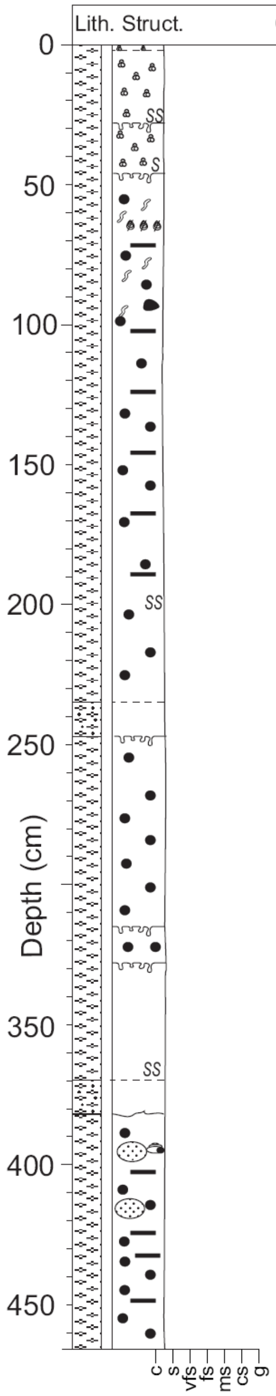
521-523 cm: level of fine sandy mud
526-528 cm: level of fine sandy mud

GeoB 15623-2	Date: 12.05.11 Pos: 42°04,35' N 09°32,65' W Water Depth: 1619 m Core Length: 532 cm



GeoB 15624-1$_{GC}$

Date: 11.05.11 Pos.: 42°03.969'N 09°32.579'W
Water depth: 1639 m Core length: 466 cm



Comments

000-002 cm: 2.5Y5/4, light olive brown soft foraminifer-bearing mud
002-028 cm: 2.5Y5/2, greyish brown foraminifer-bearing mud with moderate bioturbation

028-046 cm: 2.5Y5/1, gray foraminifer-bearing mud weakly bioturbated

046-200 cm: 4/10Y, dark greyish gray mud with moderate bioturbation and organic matter spots and bands, higher bioturbation toward the top of the unit (mainly zoophycos up to 100 cm deep),
065-067 cm: small shelly fragments

093 cm: rock fragment

200-235 cm: 3/10Y, very dark greenish gray mud with organic matter spots

235-247 cm: 3/10Y, very dark greenish gray very fine sandy mud

247-315 cm: 4/10Y, dark greenish gray mud with organic matter spots

315-328 cm: 5/10Y, greenish gray mud with organic matter patches

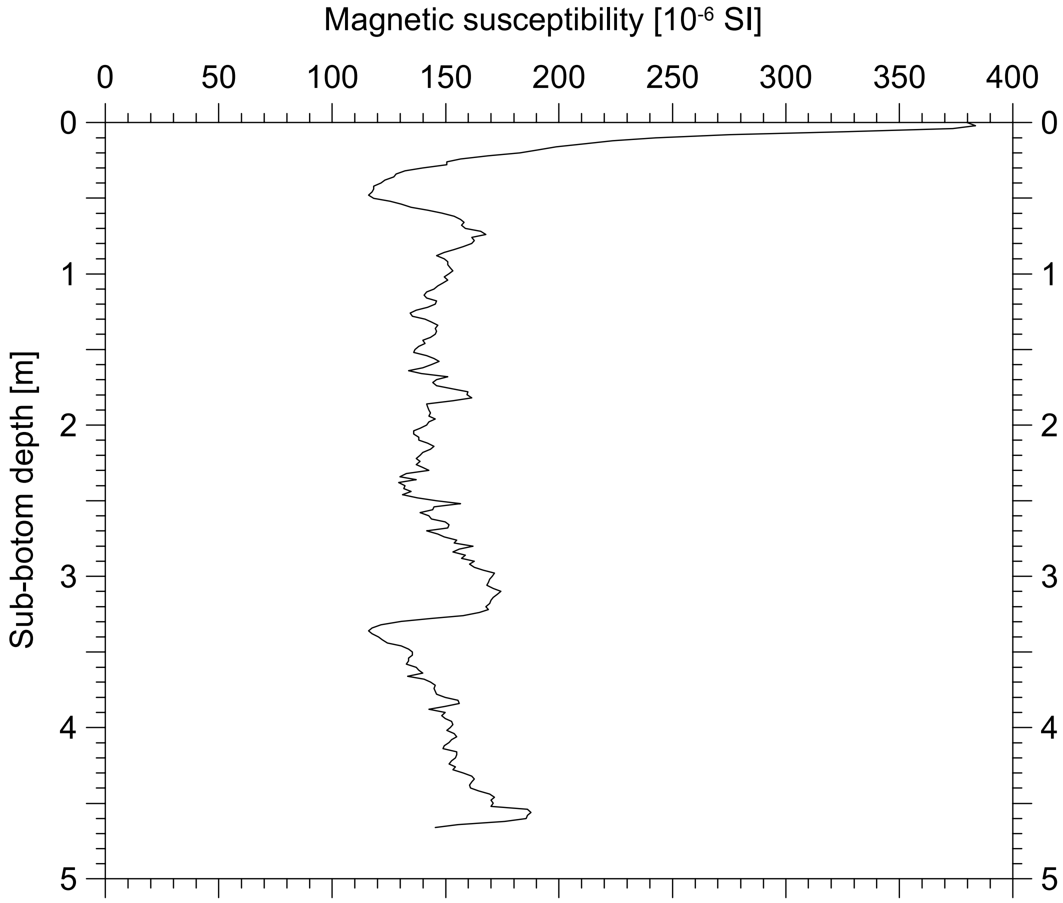
328-370 cm: 4/10Y, dark greenish gray mud with moderate bioturbation and low amounts of sand

361-366 cm: some patches of sandy sediments

370-382 cm: 4/10Y, dark greenish gray very fine sandy mud
382-466 cm: 4/10Y, dark greenish gray mud, weakly bioturbated and organic matter spots and bands
391-401 cm: sandy patch
394 cm: 2 cm long gastropod

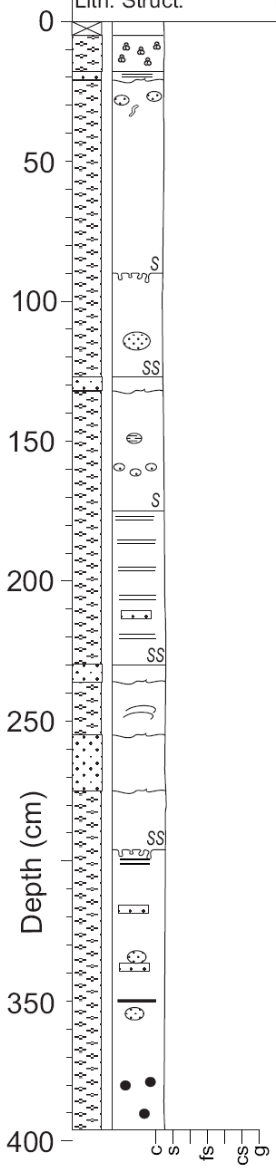
411-418 cm: sandy patch

GeoB 15624-1	Date: 12.05.11 Pos: 42°03,97' N 09°32,58' W Water Depth: 1639 m Core Length: 466 cm



GeoB 15625-1$_{GC}$

Date: 12.05.11 Pos.: 42°04.812'N 09°30.018'W
Water depth: 1598 m Core length: 396 cm



Comments

005-018 cm: 2.5Y4/2, dark greyish brown foraminifer-bearing mud

018-021 cm: 4/10Y, dark greenish gray very fine sand, some laminations are observed
021-090 cm: 5/10Y, greenish gray mud, weakly bioturbated
026 cm: patch of sandy sediments
028 cm: patch of sandy sediments
033 cm: bioturbated by zoophycos

090-127 cm: 4/10Y, dark greenish gray mud with moderate bioturbation (zoophycos)

111-118 cm: several patches of sandy sediments

127-132 cm: 4/10Y, dark greenish gray very fine sand
132-175 cm: 4/10Y, dark greenish gray mud, weakly bioturbated,

149 cm: mudclast (similar to ooze)
158-162 cm: patches of sandy sediments

175-230 cm: 4/10Y, dark greenish gray mud with laminations, moderately bioturbated,

212 cm: sandy layer

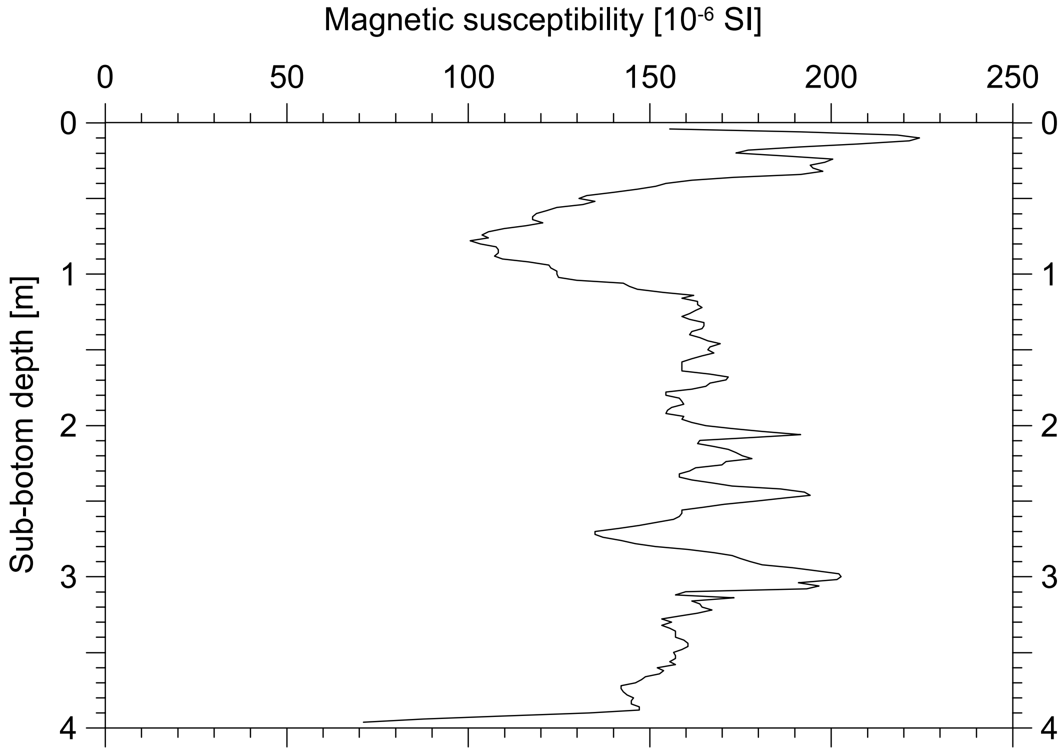
230-236 cm: 4/10Y, dark greenish gray very fine sand
236-255 cm: 4/10Y, dark greenish gray mud
247-249 cm: increased amount of very fine sand, highly deformed sediments, convoluted
255-275 cm: 4/10Y, dark greenish gray very fine sand

275-296 cm: 3/10Y, very dark greenish gray mud with moderate bioturbation

296-396 cm: 4/10Y, dark greenish gray mud, moderate bioturbation
296-304 cm: laminated sediments

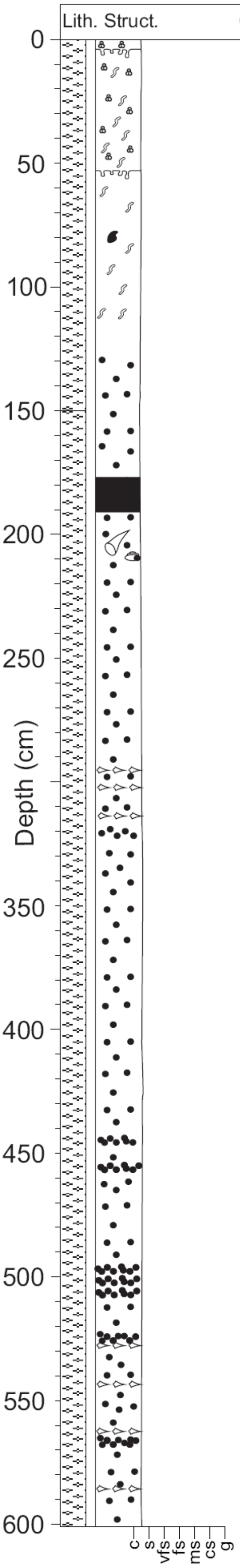
317 cm: sandy layer
334 cm: sandy patch
338 cm: sandy layer
350 cm towards the base of the core: layers of high organic matter content, gently undulated
351 cm: dark layer
354 cm: sandy patch

GeoB 15625-1	Date: 12.05.11 Pos: 42°04,81' N 09°30,02' W Water Depth: 1598 m Core Length: 396 cm



GeoB 15628-2$_{GC}$

Date: 12.05.11 Pos.: 42°15.214'N 09°38.195'W
Water depth: 1965 m Core length: 603 cm



Comments

000-004 cm: 2.5Y4/4, olive brown soft foraminifer-bearing mud
004-053 cm: 2.5Y5/1, gray foraminifer-bearing mud with moderate bioturbation (planolites, zoophycos)

053-603 cm: 4/10Y, dark greenish gray mud, with moderate bioturbation (zoophycos)

78-82 cm: dark patch
zoophycos up to 117 cm deep
organic matter spots become frequent from 129 cm downwards

177-191 cm: dark band

203 cm: scaphopd about 8 cm long
209 cm: gastropod about 3 cm long

294-297 cm: pteropods patch
301-304 cm: pteropods patch
313-315 cm: pteropods patch
318-323 cm: band of increased organic matter

443-447 cm: band of increased organic matter
454-458 cm: band of increased organic matter

494-508 cm: band of increased organic matter

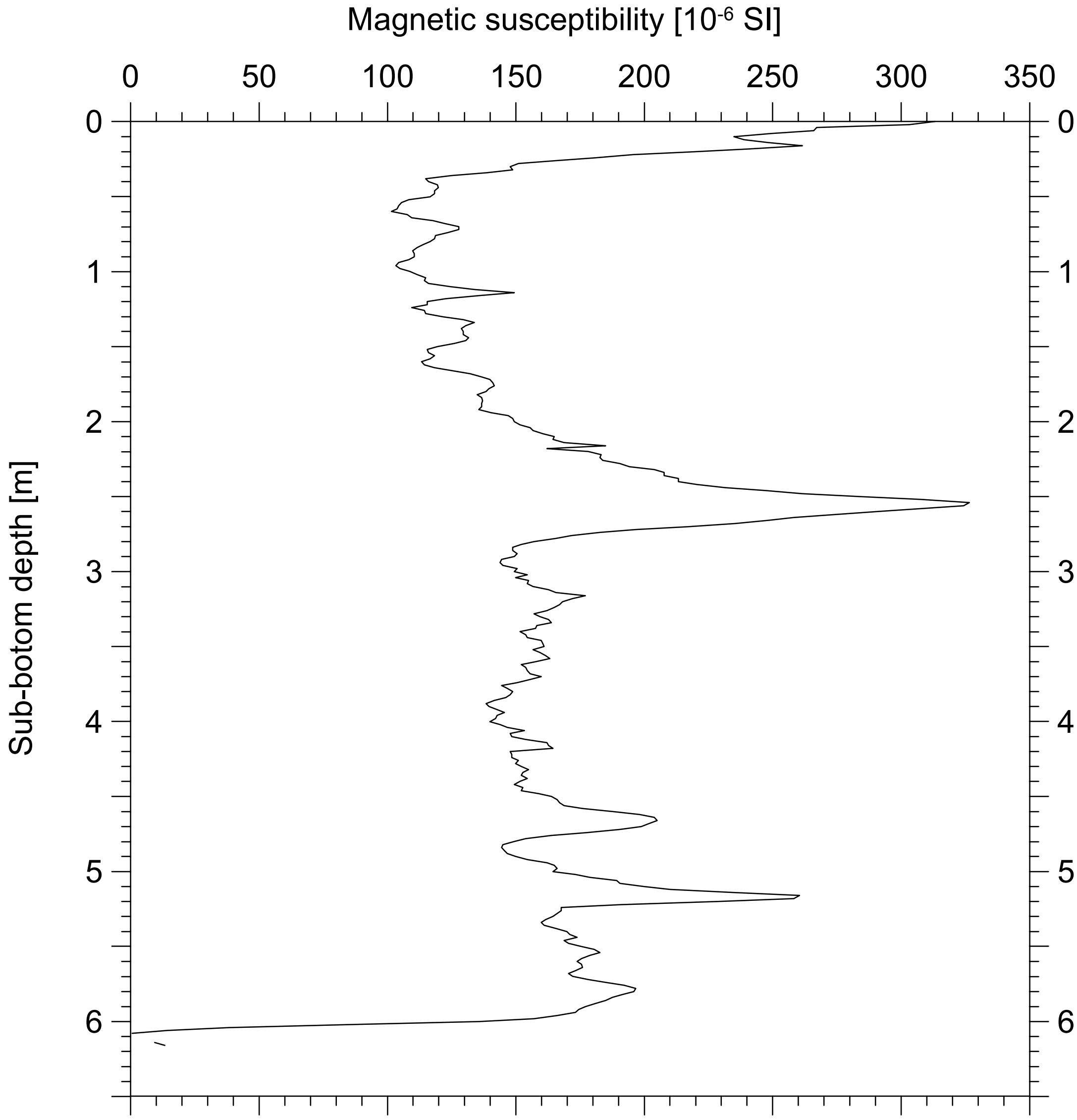
522-528 cm: band of increased organic matter
527-528 cm: pteropods level

543-544 cm: pteropods level

562-563 cm: pteropods level
565-568 cm: band of increased organic matter

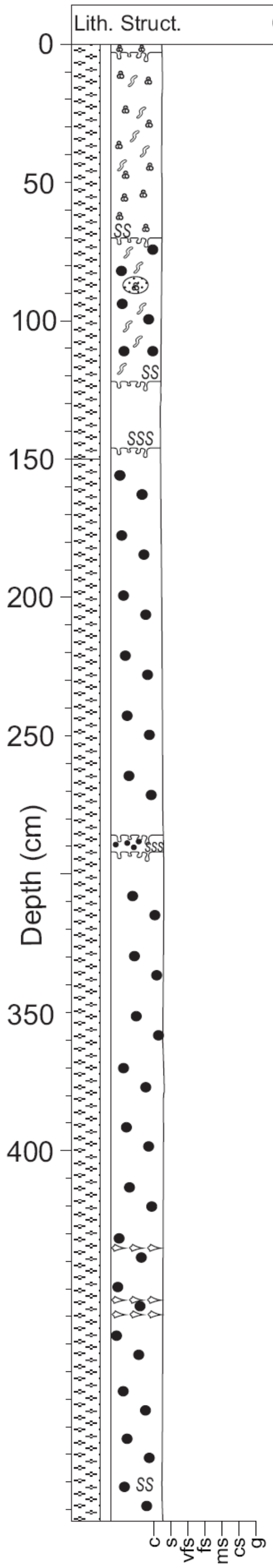
585-587 cm: pteropods level

GeoB 15628-2	Date: 14.05.11 Pos: 42°15,21' N 09°38,20' W Water Depth: 1965 m Core Length: 603 cm



GeoB 15629-2$_{GC}$

Date: 14.05.11 Pos.: 42°14.474'N 09°37.194'W
Water depth: 1885 m Core length: 534 cm



Comments

000-003 cm: 2.5Y4/4, olive brown soft foraminifer-bearing mud
003-070 cm: 2.5Y5/1, gray foraminifer-bearing mud with moderate bioturbation (planolites and zoophycos)

070-122 cm: 5/10Y, greenish gray mud with moderate bioturbation (zoophycos), very scarce organic matter spots
086-90 cm: sandy patch with abundant foraminifer

122-146 cm: 3/10Y, very dark greenish gray mud, strongly bioturbated

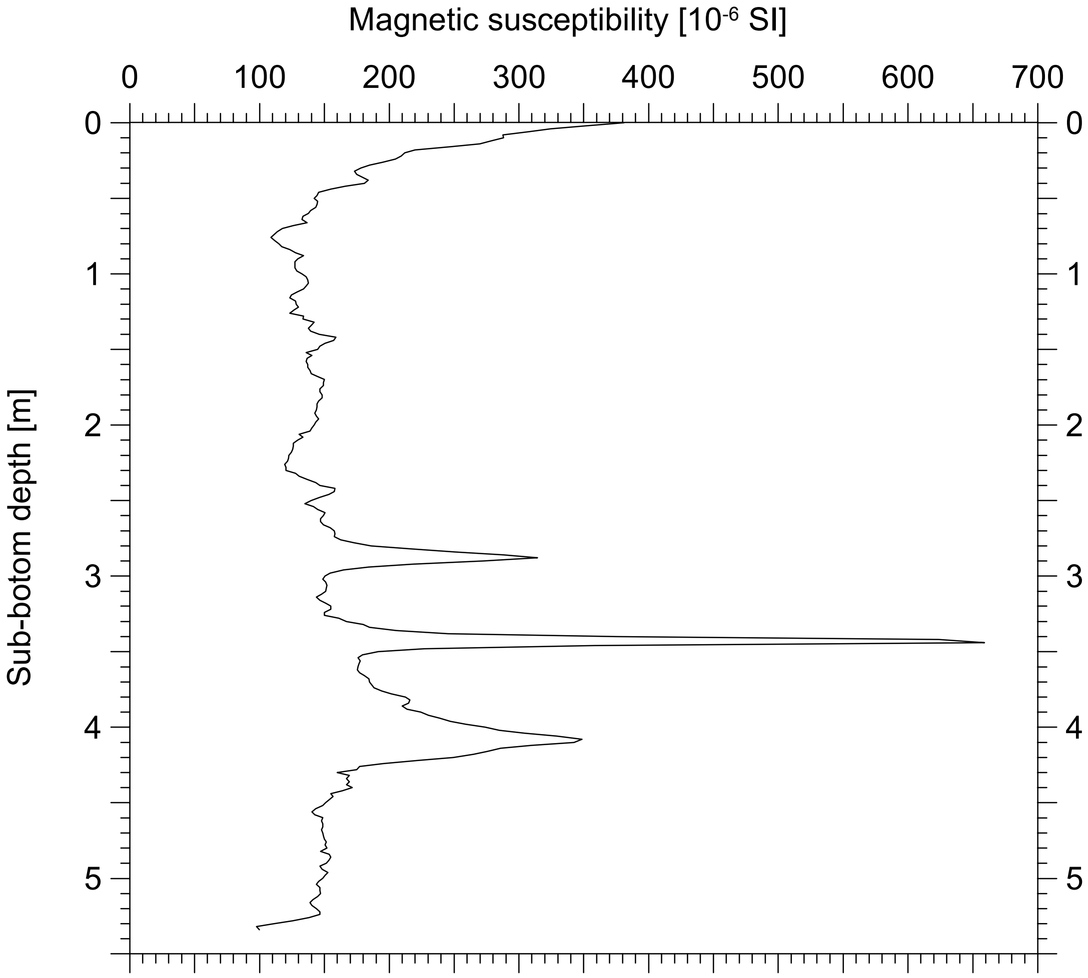
146-286 cm: 4/10Y, dark greenish gray mud with moderate bioturbation and organic matter spots

286-292 cm: 4/10Y, dark greenish gray mud with some browny patches (occurance of sands), strongly bioturbated and numerous organic matter spot
292-534 cm: 4/10Y, dark greenish gray mud with moderate bioturbation and organic matter spot

434-438 cm: pteropods layer

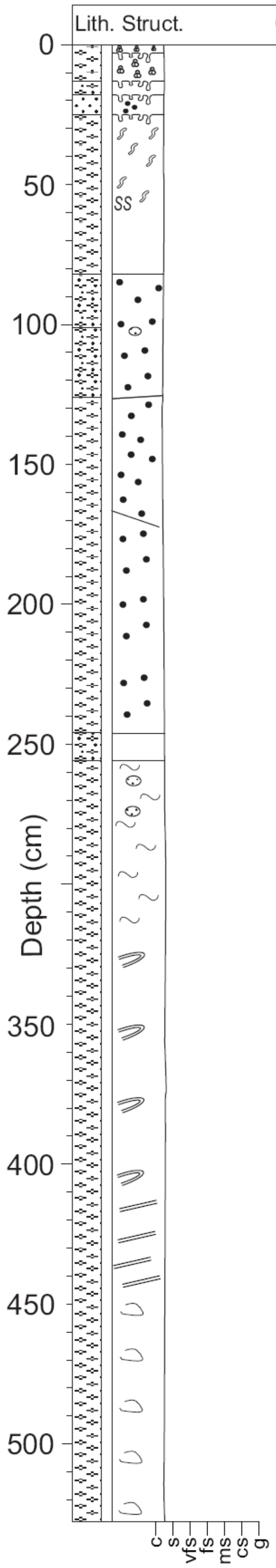
452-454 cm: pteropods layer
458-462 cm: pteropods layer

GeoB 15629-2	Date: 14.05.11 Pos: 42°14,47' N 09°37,19' W Water Depth: 1885 m Core Length: 534 cm



GeoB 15630-2$_{GC}$

Date: 14.05.11 Pos.: 42°13.81'N 09°35.35'W
Water depth: 1891 m Core length: 528 cm



Comments

000-003 cm: 2.5Y5/3, light olive brown soft foraminifer-bearing mud
003-013 cm: 2.5Y4/1, dark gray foraminifer-bearing mud
013-018 cm: 2.5Y4/2, dark greyish brown sandy mud
018-025 cm: 4/10Y, dark greenish gray glauconite sands
025-082 cm: 4/10Y, dark greenish gray mud with moderate bioturbation (zoophycos: up to 60 cm deep)

082-126 cm: 5/10Y, greenish gray very fine sandy mud with scarce organic matter spots

101-104 cm: sandy patch

126-170 cm: 4/56Y, dark greenish gray mud with scattered sandy spots and organic matter spots

170-246 cm: 3/10Y, very dark greenish gray mud with scattered organic matter spots

246-256 cm: 4/10Y, dark greenish gray sandy mud
256-528 cm: 4/10Y, dark greenish gray mud with widespread signs of mass movement: deformed, folded and convolved packages alternate with laterally dipping layers and/or with undulated layers
263 cm: sandy patch
274 cm: sandy patch

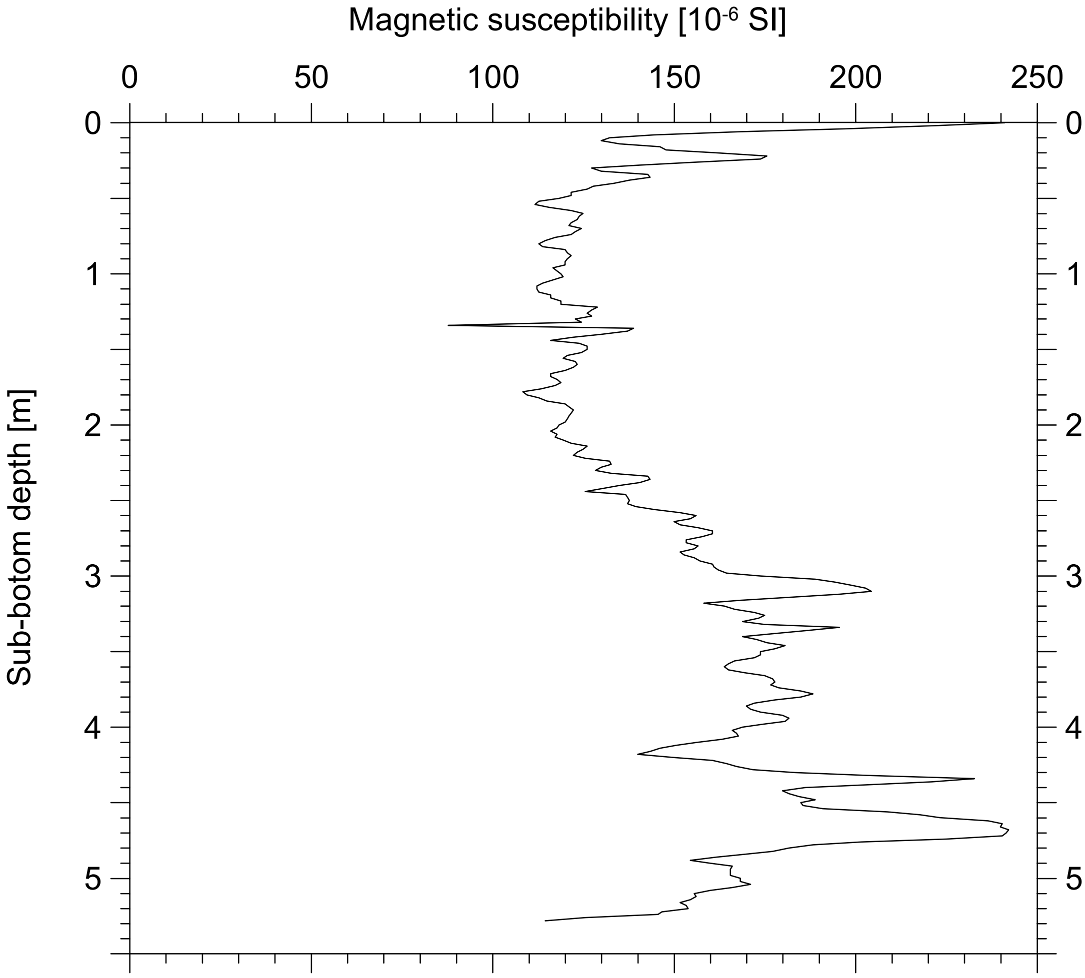
up to 321 cm: dominance of slightly contorted layers

up to 409 cm: strongly deformed sediment packages with convoluted sediments and folds

Up to 447 cm: more laminated sediments but filled and with evidences of deformation

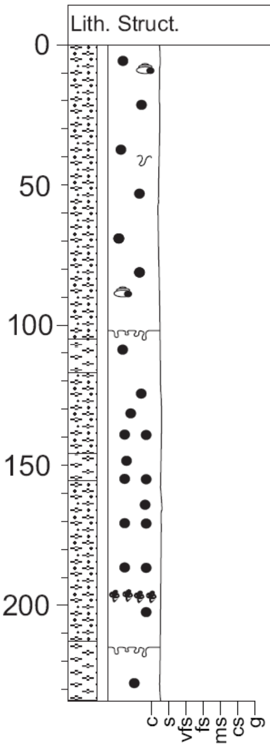
Up to the end: dominance of folded and contorted sediments again

GeoB 15630-2	Date: 14.05.11 Pos: 42°13,81' N 09°35,35' W Water Depth: 1891 m Core Length: 528 cm



GeoB 15631-2$_{GC}$

Date: 15.05.11 Pos.: 41°54.909'N 09°2.423'W
Water depth: 101 m Core length: 235 cm



Comments

000-102 cm: 2.5/10Y, greenish black sandy mud, spots of organic matter
008 cm: gastropod

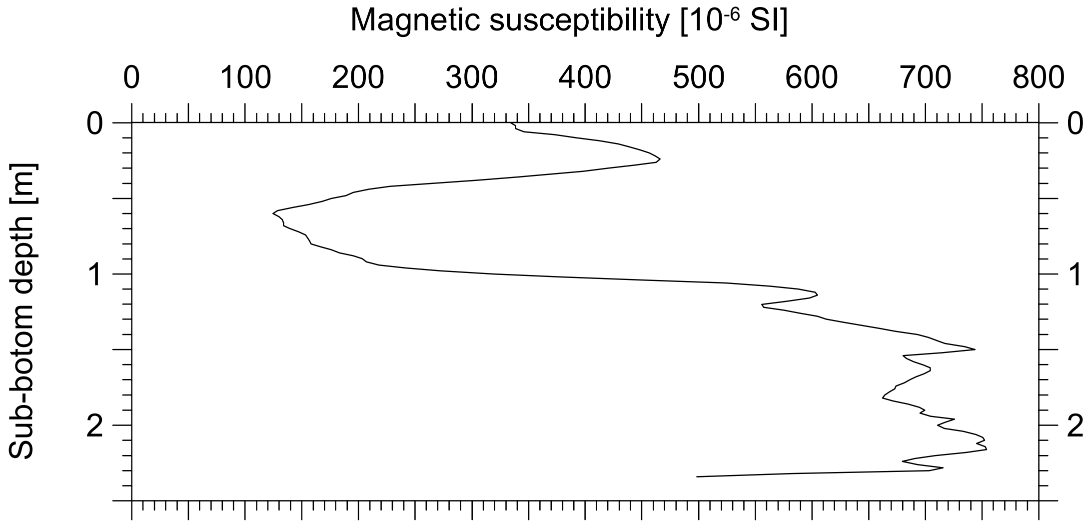
041 cm: worm tube

088 cm: gastropod

102-213 cm: alternance of greenish black (with high amounts of organic matter) and very dark greenish gray muds, dark band with high amount of plant remains at 197 cm depth

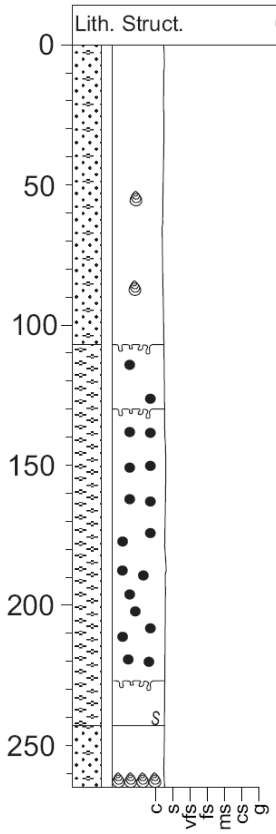
213-234 cm: 2.5/10Y, greenish black mud

GeoB 15631-2	Date: 15.05.11 Pos: 41°54,91' N 09°02,42' W Water Depth: 101 m Core Length: 235 cm



GeoB 15632-2$_{GC}$

Date: 15.05.11 Pos.: 41°55.405'N 09°2.426'W
Water depth: 103 m Core length: 265 cm



Comments

000-107 cm: 2.5/10Y, greenish black muddy sand

55 cm: bivalve shell

97-98 cm: bivalve shell

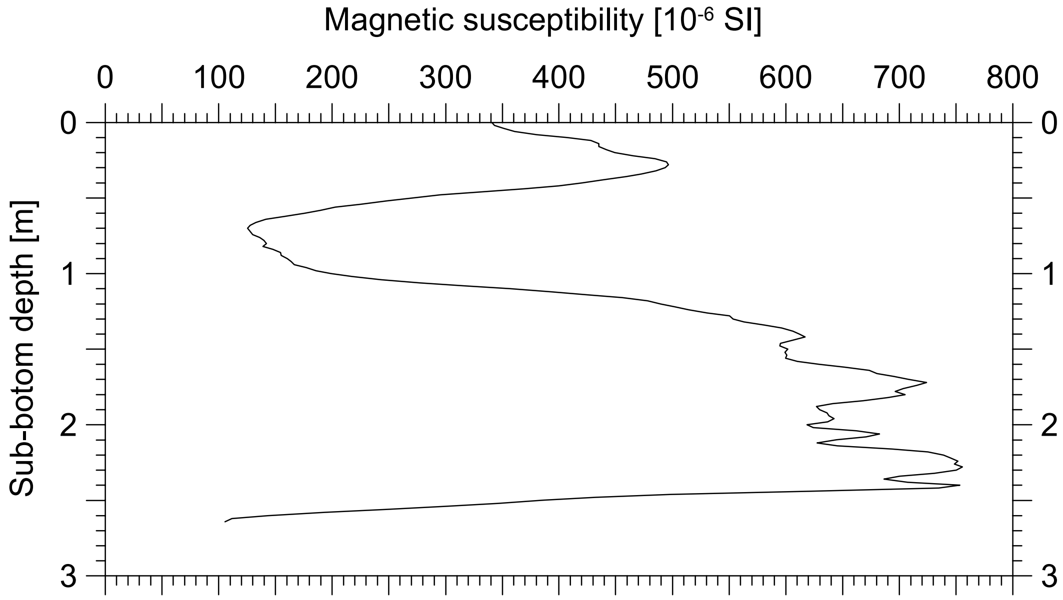
107-130 cm: 3/10Y, very dark greenish gray mud with scarce organic matter spots

130-227 cm: alternance of greenish black and very dark greenish gray muds, high amounts of organic matter

227-243 cm: 2.5/56Y, greenish black mud, weakly bioturbated

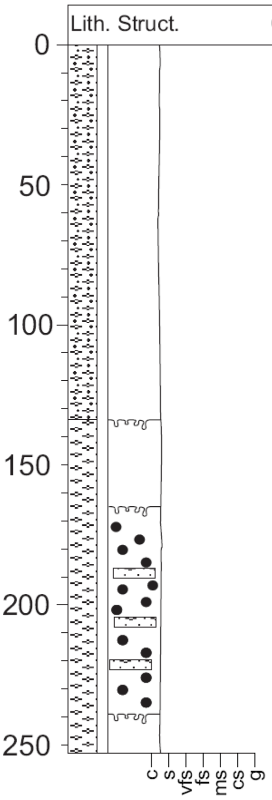
243-265 cm: 2.5/106Y, greenish black muddy sand, high amount of shell at the base

GeoB 15632-2	Date: 15.05.11 Pos: 41°55,41' N 09°02,42' W Water Depth: 103 m Core Length: 265 cm



GeoB 15633-2$_{GC}$

Date: 15.05.11 Pos.: 41°58.413'N 09°2.418'W
Water depth: 109 m Core length: 253 cm



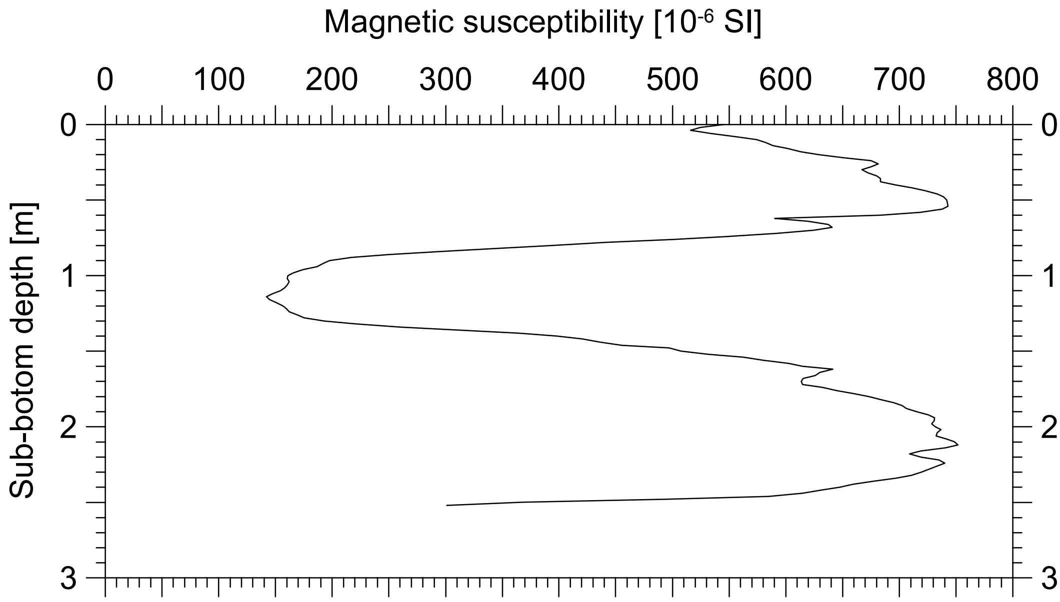
000-134 cm: 2.5/10Y, greenish black sandy mud

134-165 cm: 3/10Y, very dark greenish gray mud

165-239 cm: 2.5/N, alternance of greenish black and very dark greenish gray muddy bands with abundance of organic matter spots

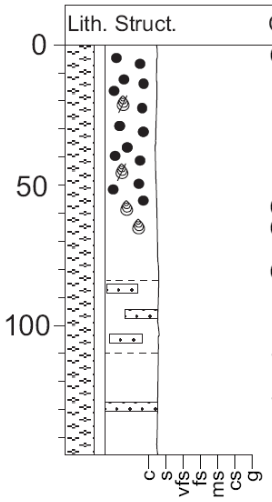
239-253 cm: 2.5/N, black mud

GeoB 15633-2	Date: 15.05.11 Pos: 41°58,41' N 09°02,43' W Water Depth: 109 m Core Length: 253 cm



GeoB 15645-2$_{GC}$

Date: 19.05.11 Pos.: 41°55.01'N 09°04.00'W
Water depth: 116 m Core length: 146 cm



Comments

000-084 cm: 2.5/10Y, greenish black mud with some organic matter spots and very scarce shell fragments

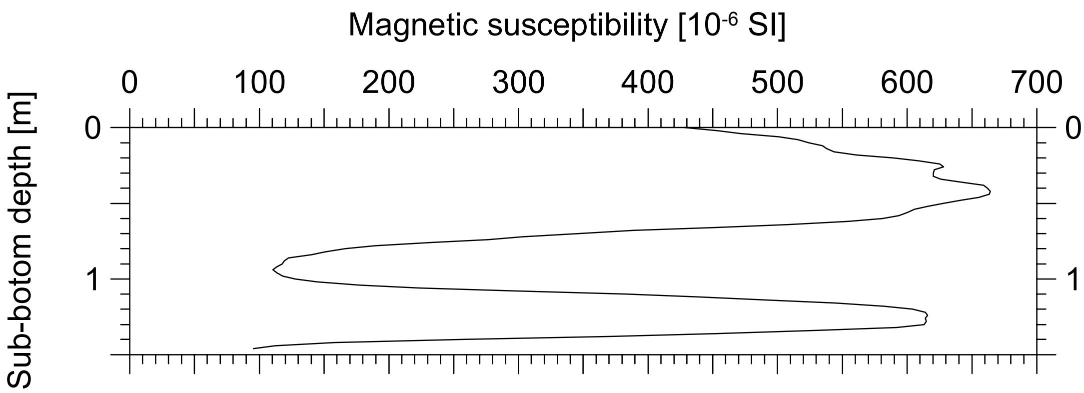
059 cm: shell fragment
065 cm: shell fragment

084-110 cm: 2.5/10Y, greenish black mud with low amount of sand

110-146 cm: 3/10Y, very dark greenish gray mud with high amount of organic matter

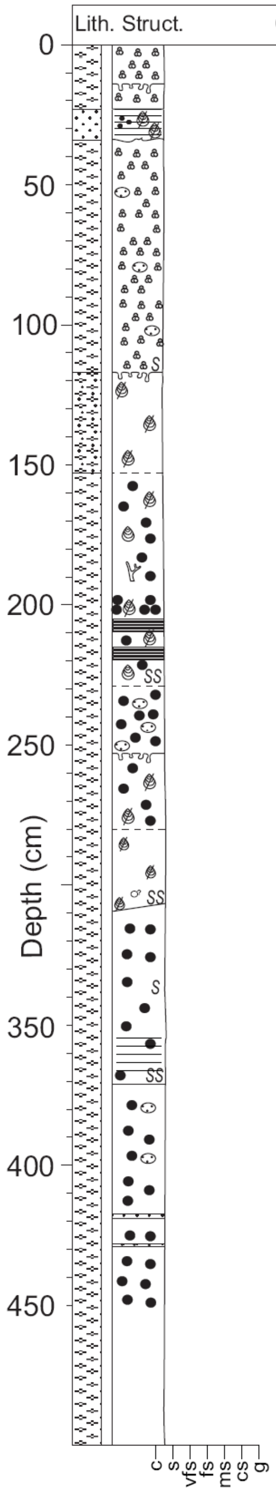
129 cm: sandy layer

GeoB 15645-2	Date: 19.05.11 Pos: 41°55,01' N 09°04,00' W Water Depth: 116 m Core Length: 146 cm



GeoB 15658-2$_{GC}$

Date: 20.05.11 Pos.: 41°58.726'N 09°26.650'W
Water depth: 1394 m Core length: 451 cm



Comments

000-014 cm: 2.5Y4/2, dark greyish brown foraminifer-bearing mud
014-023 cm: 2.5Y5/1, gray foraminifer-bearing mud with some sandy lenses
023-034 cm: 2.5Y3/1, very dark gray laminated sand, some intercalated black layers (glauconite) and shell fragments
034-117 cm: 2.5Y5/1, gray foraminifer-bearing mud with some sandy lenses, weak bioturbation

117-153 cm: 4/10Y, dark greenish gray sandy mud with occasional shell fragments

153-229 cm: 4/10Y, dark greenish gray mud with frequent shell fragments, moderately bioturbation, frequent organic matter spots

188 cm: Ophelia (Coral)
200 cm: shell fragment
198-202 cm: high amount of organic matter
203-229 cm: alternance of darker and lighter bands

229-254 cm: 5/10Y, greenish gray mud with organic matter spots and scarce sandy lenses

254-280 cm: 4/10Y, dark greyish gray mud with frequent shell fragments and organic matter spots

280-308 cm: 4/10Y, dark greenish gray mud with small shell fragments, moderately bioturbated

306 cm: unknown spot
308-371 cm: 5/10Y, greenish gray mud with organic matter spots and weak to moderate bioturbated

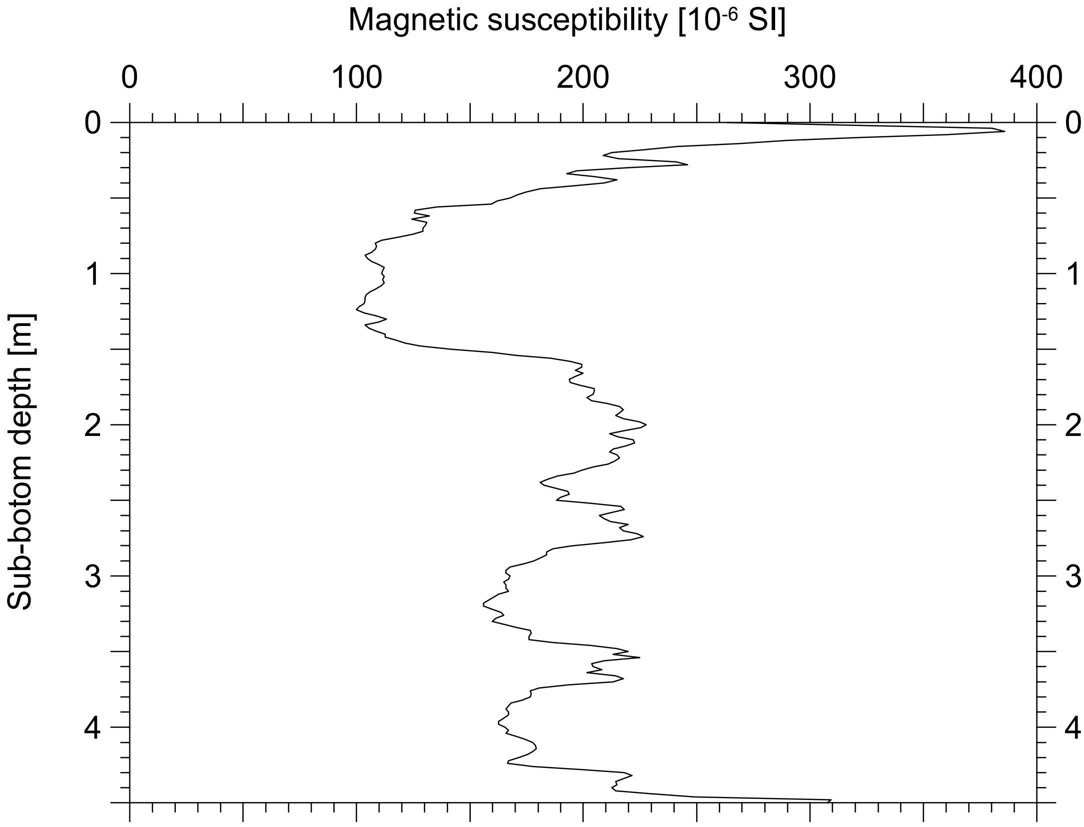
352-371 cm: moderately bioturbated (laminated)

371-428 cm: 4/10Y, dark greenish gray mud with organic matter spots and sandy lenses

419 cm: sandy layer
428-451 cm: 2.5/10Y, greenish black mud with abundant organic matter
428-429 cm: sandy layer

GeoB 15658-2

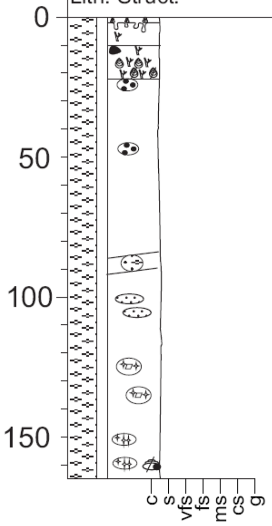
Date: 20.05.11 Pos: 41°58,73' N 09°26,65' W
Water Depth: 1394 m Core Length: 451 cm



GeoB 15659-2$_{GC}$

Date: 20.05.11 Pos.: 41°59.184'N 09°27.916'W
Water depth: 1406 m Core length: 165 cm

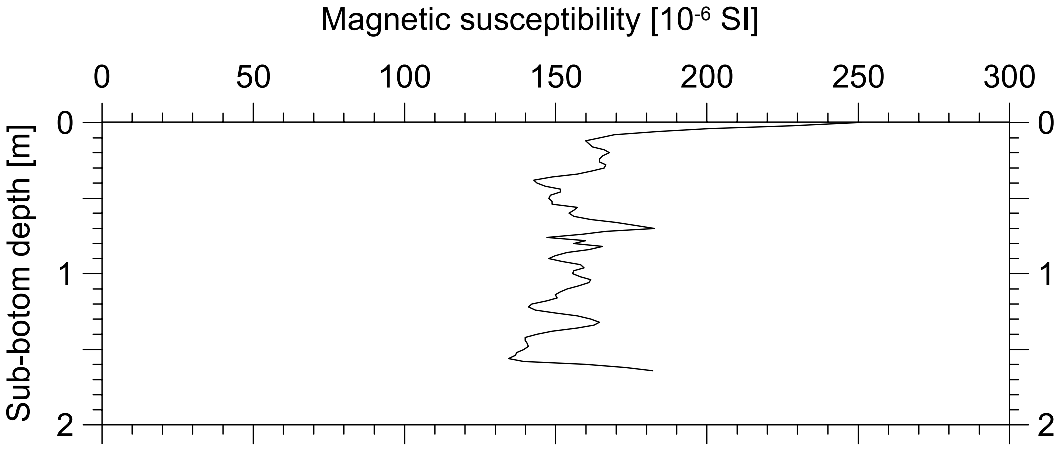
Lith. Struct. Comments



000-002 cm: 2.5Y5/6, light olive soft foraminifer-bearing mud with some glauconite
002-010 cm: 2.5Y4/1, dark gray mud
008 cm: Ophelia (Coral) 4 cm long
012 cm: Ophelia (Coral) 3 cm long
010-022 cm: 2.5Y4/1, dark gray heterolithic mixture with corals, shell fragments
Sandstone (4 cm long) at 12 cm depth
Ophelia (coral) at 14 cm depth (3 cm long)
022-085 cm: 4/10Y, dark greenish gray mud
022-027 cm: inclined sandy intercalations, mainly composed of glauconite medium sandy
044-049 cm: inclined sandy intercalations, more heterolithic few organic matter spots
085-091 cm: 3/10Y, very dark greenish gray mud with a lens of very fine muddy sand at the top
091-148 cm: 4/10Y, dark greenish gray mud

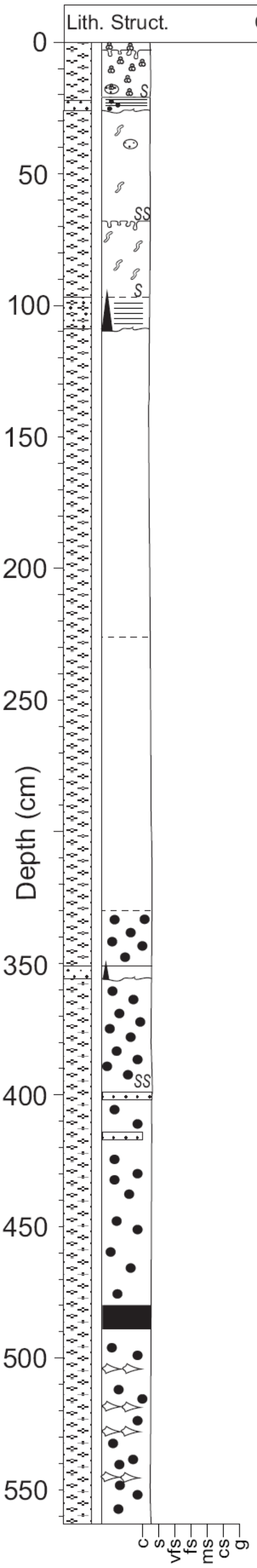
102 cm: very fine sand intercalations (inclinched)
108 cm: very fine sand intercalations (inclinched)
124-126 cm: patch of heterolithic material
127 cm: lighter band
134-136 cm: patch of heterolithic material weak bioturbation, scarce organic matter spots
153 cm: bioclastic and lithogenic materials in the lower part of the core
163 cm: bioclastic and lithogenic materials in the lower part of the core, broken gastropod

GeoB 15659-2	Date: 20.05.11 Pos: 41°59,18' N 09°27,92' W Water Depth: 1406 m Core Length: 165 cm



GeoB 15660-2$_{GC}$

Date: 20.05.11 Pos.: 41°58.980'N 09°28.681'W
Water depth: 1403 m Core length: 563 cm



Comments

000-003 cm: 2.5Y5/4, light olive brown very soft foraminifer-bearing mud
003-021 cm: 2.5Y4/1, dark gray mud with abundant foraminifers and weakly bioturbated
018 cm: sandy lenses with foraminifers
021-026 cm: 4/10Y, dark gray sand with alternating glauconitic bands, strongly laminated
026-068 cm: 5/10Y, dark greenish gray mud with small sandy lenses (e.g. at 38 cm), moderate bioturbation, planolites, zoophycos)

068-097 cm: 4/10Y, dark greenish gray mud, weakly bioturbated (zoophycos)

097-109 cm: 4/10Y, dark greenish gray sandy mud, showing a fining-upward trend, laminations (resolved by darker-lighter bands)
109-226 cm: 4/10Y, dark greenish gray sandy mud

226-330 cm: 4/10Y, dark greenish gray muds with moderate to low amounts of sand

330-351 cm: 4/10Y, dark greenish gray mud with organic matter spots
351-356 cm: 4/10Y, dark greenish gray very fine sands, showing a fining -upward trend
356-563 cm: 4/10Y, dark greenish gray mud with organic matter spots
356-400 cm: moderate bioturbation with frequent organic matter

400 cm: increased amount of very fine sands

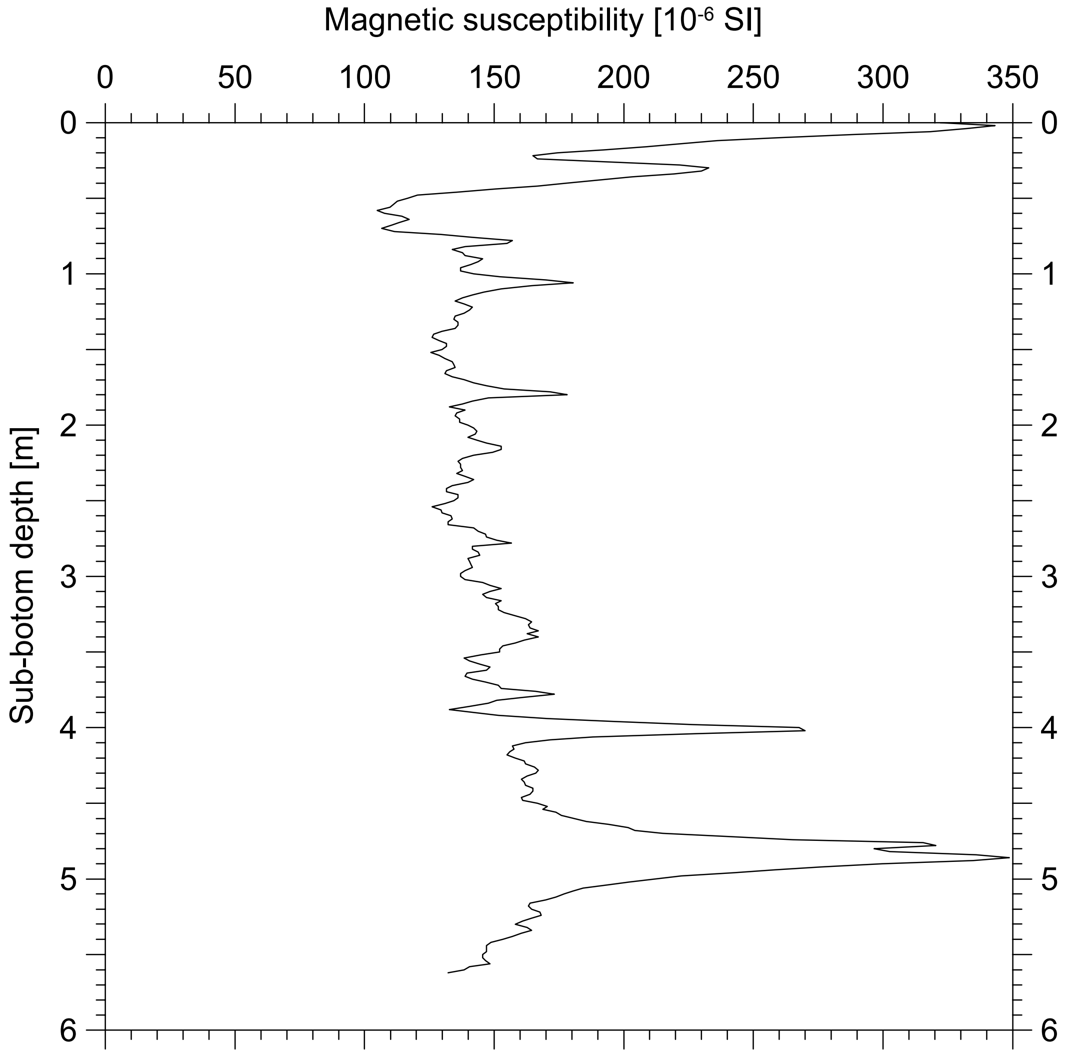
414-418 cm: increased amount of sand

480-489 cm: dark band

504 cm: pteropods level
518 cm: pteropods level
529 cm: pteropods level

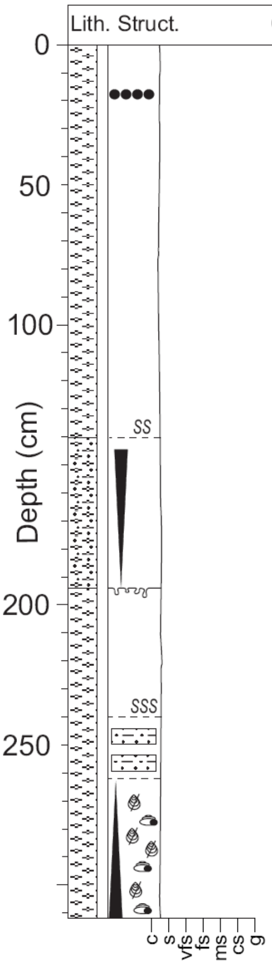
546 cm: pteropods level

GeoB 15660-2	Date: 20.05.11 Pos: 41°58,98' N 09°28,68' W Water Depth: 1403 m Core Length: 563 cm



GeoB 15673-1$_{GC}$

Date: 23.05.11 Pos.: 42°12.998'N 09°0.679'W
Water depth: 112 m Core length: 312 cm



Comments

000-140 cm: 2.5/10Y, greenish black mud with moderate bioturbation

016-017 cm: organic matter level

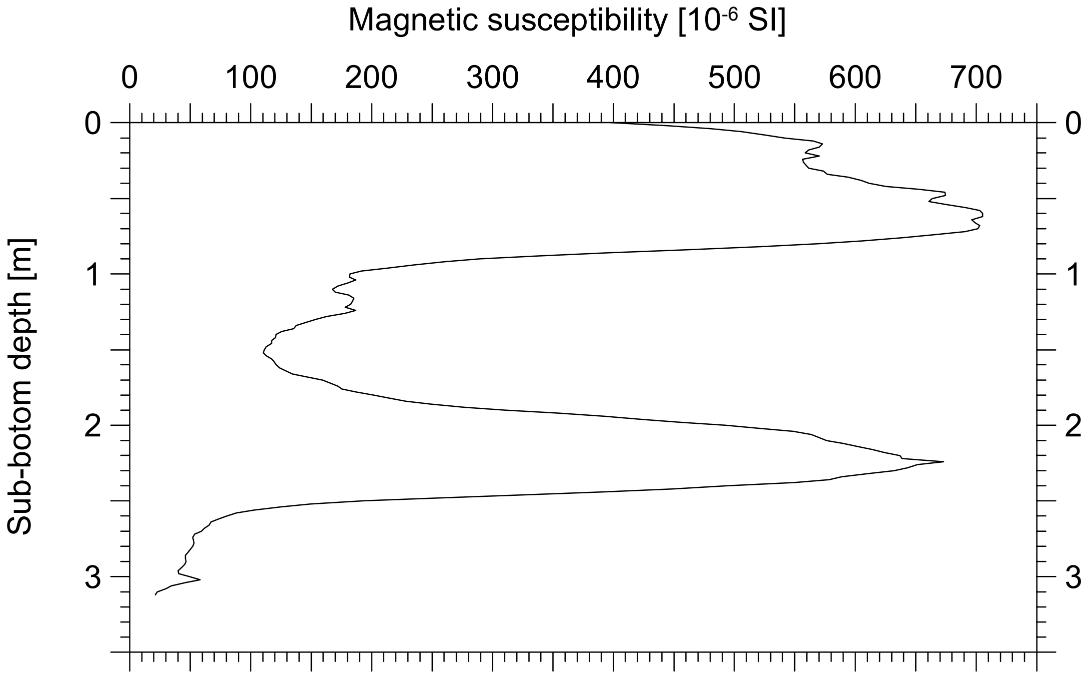
140-194 cm: 2.5/564, greenish black sandy mud with a coarsening upward trend

194-240 cm: 2.5Y4/2, dark greyish brown mud, strongly bioturbated

240-262 cm: 2.5Y106Y, greenish black mud with small amounts of very fine sands

262-312 cm: 2.5/10Y, greenish black mud with a finig-upward trend, frequent shell fragments and Gastropods

GeoB 15673-1	Date: 23.05.11 Pos: 42°13,00' N 09°00,38' W Water Depth: 112 m Core Length: 312 cm



5.7 Pore-Water Extraction

(A. Andrade Grande, I. Rodríguez Germade)

Pore water was extracted with the objective of studying the diagenetical processes taking place on the mud belt. More specifically, it is expected to find the current position of the iron and manganese (oxi-) hydroxides reduction fronts, and the sulphate-methane transition zone. This will be achieved by determining the concentration of iron, manganese and trace metals both in pore water and in sediments, as well as the concentration of sulphide and sulphate in pore water. These results, combined with the results of the isotope ratio $^{13}C/^{12}C$ of the sedimentary organic matter are expected to provide information about the relationship between the intensity of the diagenetic processes on the continental shelf and the nature and provenance of the organic matter. Further studies of solid phase geochemistry may help to the identification of pre-existing redox fronts that may provide diagenetic changes related to palaeoclimate and/or palaeoceanographic variability in the area.

For pore-water extraction, tiny holes were drilled in each core liner for insertion of *Rhizon core solution samplers* at selected depths (Fig. 5.24). Pore water was extracted with syringes and the total volume extracted by each syringe was divided in three sub-samples:

Subsample a: Selected for measuring sulphide concentration. Zinc acetate was added to these subsamples.

Subsample b: Selected for measuring metal concentration. Suprapure nitric acid was added to these subsamples.

Subsample c: Selected for measuring sulphate concentration. No additives were added to these subsamples.

Pore water was extracted from the following cores:

GeoB 15673-1 (41 samples, extracted every 5-10 cm);

GeoB 15675-2 (12 samples, extracted every 5 cm);

GeoB 15679-2 (20 samples, extracted every 5-10 cm).

Fig. 5.24: Pore-water extraction using series of rhyzons.

5.8. Acoustic Doppler Current Profiling (ADCP)

(H. Müller, B. Baasch, T. von Dobeneck, A. Andrade, I. Rodriguez Germade)

5.8.1 Methods

Current velocity and direction were measured on the Galician shelf using a 75 kHz and a 38 kHz ADCP. Measurements were performed along a continuous track starting on May 26th 9:30 am (UTC) until May 27th 5:00 am (UTC) during rough weather conditions (around 7 bft.). Current velocity and direction are calculated by using the Doppler shift produced by particles passing four narrow acoustic beams submitted by the ADCP.

The RD Instruments ADCP permanently installed on the ship's hull operates with a frequency of 75 kHz measuring current velocity and direction. The system was configured to collect data in 4 m steps (100 bins) up to depth of 400 m in narrow band mode. The incoming data were corrected for the ships movement using the ship's GPS navigation and gyre system. Additionally to the raw data, two different smoothed data sets were recorded averaging over an interval of 3, 5 and 10 minutes. Data stored in these averages were also filtered for data points with more than 50% reliability. This allowed fast visualizing and quality control of the recorded data on board.

Additionally the non permanent installed 38 kHz RD Instruments ADCP was used. The instrument also acquired data in narrow band mode. The maximum target depth was set to 2000 m in 32 m steps (50 bins). The collected values were averaged over an interval of 3, 5 and 10 minutes.

Table 10: ADCP Profiles on the Galician Shelf.

Profile	Start		End		Length
ADCP001	42° 04.270' N	9° 23.100' W	42° 04.270' N	8° 57.735' W	63.3 km
ADCP002	41° 57.950' N	8° 57.735' W	41° 57.950' N	9° 15.015' W	43.0 km
ADCP003a	41° 57.950' N	9° 15.015' W	42° 20.100' N	9° 11.800' W	41.2 km
ADCP003b	42° 20.100' N	9° 11.800' W	42° 36.610' N	9° 18.005' W	31.7 km
ADCP004	42° 36.610' N	9° 18.005' W	42° 25.640' N	9° 23.650' W	21.7 km
ADCP005	42° 25.640' N	9° 23.650' W	42° 25.530' N	9° 01.775' W	54.9 km
ADCP006	42° 26.420' N	9° 01.610' W	42° 28.080' N	9° 10.250' W	21.7 km

5.8.2 Data and Preliminary Results

A total profile length of 277.6 km was acquired along 6 profiles that follow EM tracks performed during cruises M84/4 and P366/3a on the Galician shelf between 41° 58’ N and 42° 37’ N (Tab. 10).

Exemplary data of 75 kHz ADCP measurements along profile ADCP003a and b (Fig. 5.25) indicate an inverse current direction of higher velocity in surface water (0-40m) in the northern part of the profile (Ensemble 127 – 150; 42° 26.3’ N – 42° 36.2’ N). At all, data quality is limited due to rough sea conditions.

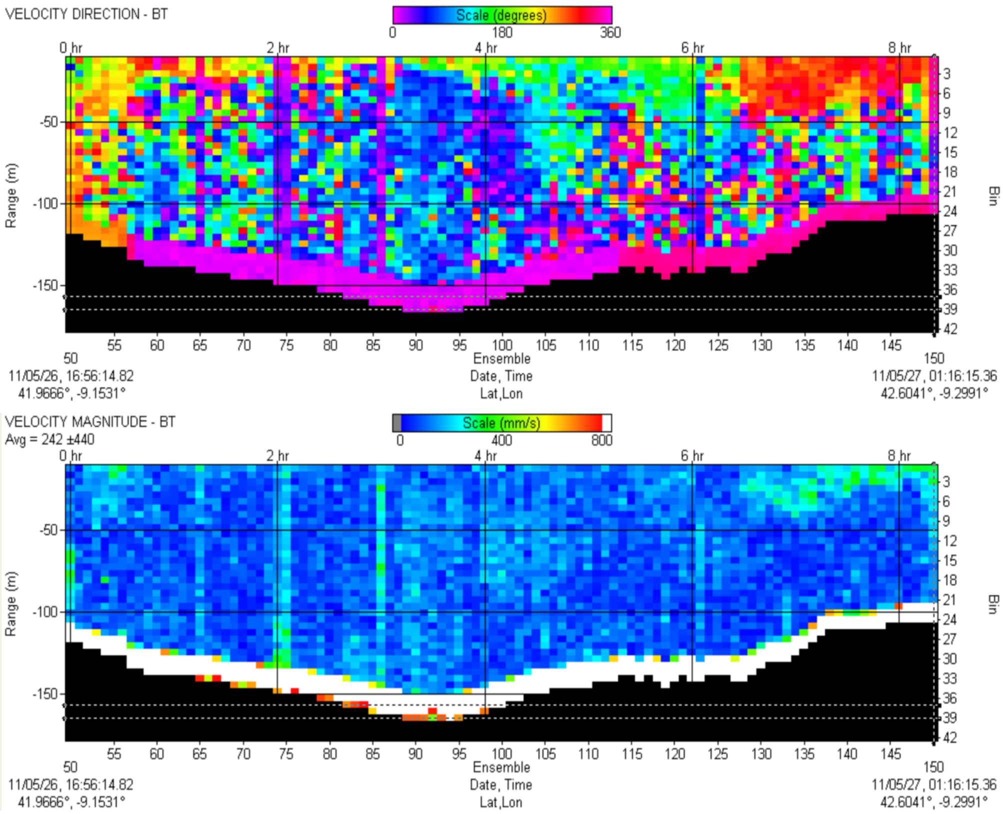


Fig. 5.25: 75 kHz ADCP data of Profile ADCP003a&b (S-N): Upper part shows the current direction; the lower part shows current velocity.

5.9 Water Sampling

(Karl-Heinz Baumann)

Coccolithophores constitute a significant part of the oceanic phytoplankton in the photic zone of the oceans and play a unique role in the global carbon cycle as primary producers and marine calcifiers. Recent concerns about climate change and the effects of rising surface ocean temperatures and possibly increasing ocean acidification on marine organisms have triggered an increasing interest in coccolithophore ecology. It is currently not known if at all and how coccolithophore populations may adapt to proposed changes in their environment, but geographical shifts in the occurrences of species and assemblage compositions are already observed. The basic requisite to add to this aspect is the detailed knowledge of coccolithophorid spatial variations, compositions in their populations, and coccolithophorid production. Although general aspects of coccolithophorid biogeography and habitat are known from taxonomic surveys of the plankton and of bottom sediments in various oceans, little work has been done on absolute abundances relative to total phytoplankton or on absolute numbers of single species relative to ecological parameters in natural populations. Records on coccolithophores from surface waters off the Iberian Atlantic coast have been scarce so far.

Therefore, a detailed plankton sampling in a relatively small area off Galicia was carried out. At 12 stations five water samples were taken from NISKIN-bottles generally between 5 m and 100 m water depths (Table 11). The stations were arranged in two transects perpendicular to the shelf break as well as on a N-S-transect parallel to the coast on the shelf.

Fig. 5.26: The Niskin Bottles.

In addition, 41 surface water samples were taken from the vessel's membrane pump system at about 5 m water depth along the ship's transect (Table 12). Generally, up to 5 liters of sea-water were filtered through cellulose nitrate filters (50 mm diameter, 0.45 µm pore size) by means of a water jet pump immediately onboard. Without washing, rinsing or chemical conservation the filters were dried at about 45°C for at least 24 h and stored in plastic petri dishes. The filtered material will later be studied using a Scanning Electron Microscope (SEM). Species composition and abundance will be determined by identification and counting on measured filter transects.

Table 11: Water samples taken from Niskin-bottles for coccolithophore analysis.

GeoB No.	Sample No.	Date	Location Latitude (N)	Longitude (W")	Water Depth [m]	Sampling Depths [m]	Filtered Volume [l]
15606-1	I-1	4.5.11	42° 26,21'	09° 38,19'	3595	5	3,5
	I-2					25	3,5
	I-3					50	2,0
	I-4					75	4,0
	I-5					100	4,75
15609-1	II-1	5.5.11	42° 24,65'	09° 47,35'	1938	5	4,0
	II-2					25	3,0
	II-3					50	5,0
	II-4					75	5,0
	II-5					100	5,0
15613-3	III-1	7.5.11	42° 27,05'	10° 03,00'	2642	5	3,0
	III-2					25	3,0
	III-3					50	2,0
	III-4					75	4,5
	III-5					100	5,0
15618-1	IV-1	11.5.11	42° 38,05'	09° 53,67'	2000	5	3,75
	IV-2					25	4,0
	IV-3					50	2,75
	IV-4					75	4,5
	IV-5					100	5,0
15647-1	V-1	19.5.11	42° 07,02'	08° 58,82'	98	5	2,0/1,3
	V-2					20	3,0
	V-3					40	3,50
	V-4					60	4,0
	V-5					80	4,0
15653-1	VI-1	19.5.11	42° 07,01'	09° 08,54'	144	5	2,0
	VI-2					20	2,6
	VI-3					40	3,50
	VI-4					60	5,0
	VI-5					80	5,0
15656-1	VII-1	19.5.11	42° 06,99'	09° 20,00'	220	5	2,75
	VII-2					20	2,5
	VII-3					40	3,0
	VII-4					60	4,7
	VII-5					80	5,0
15623-3	VIII-1	19.5.11	42° 04,36'	09° 32,69'	1621	5	2,5
	VIII-2					25	2,75
	VIII-3					50	3,0
	VIII-4					75	4,5
	VIII-5					100	4,5
15623-3	IX-1	20.5.11	41° 59,20'	09° 25,70'	1330	5	3,0
	IX-2					25	2,5
	IX-3					50	4,5
	IX-4					75	5,0
	IX-5					100	5,0
15663-1	X-1	21.5.11	42° 30,23'	09° 15,71'	126	5	2,0
	X-2					20	1,5
	X-3					40	2,0
	X-4					60	5,0
	X-5					80	5,0
15688-3	XI-1	24.5.11	42° 27,71'	09° 20,99'	325	5	2,0

Table 12: Surface water samples (5m depth) taken vessel’s membrane pump system.

Sample No.	Date	Time (MESZ)	Location Latitude (N)	Longitude (W'')	Water Depth [m]	Temp. [°C]	Salinity	Filtered Volume [l]
# 1	1.5.11	18:10	41°57,90'	9°22,07'	242,3	16,6	35,600	3,5
# 2		23:26	42°09,00'	9°28,72'	1204,4	16,6	35,774	2,5
# 3	2.5.11	04:23	42°10,92'	9°40,18'	2091,6	16,8	35,733	3,0
# 4		08:02	42°02,40'	9°39,53'	2037,1	17,0	36,630	3,5
# 5	3.5.11	01:05	42°28,67'	9°30,61'	1477	15,8	35,709	2,5
# 6		04:57	42°42,83'	9°40,49'	1417,4	15,9	35,700	3,0
# 7		08:33	42°49,48'	9°37,71'	797,3	15,8	35,716	3,5
# 8		11:19	42°49,98'	9°53,58'	2345,4	15,2	35,851	3,5
# 9		15:09	42°31,63'	9°53,06'	2375,1	16,0	35,875	3,0
# 10		18:20	42°21,42'	9°47,09'	1979,3	16,4	35,825	3,0
# 11		21:52	42°37,73'	9°48,73'	1885,3	15,7	35,851	2,75
# 12	6.5.11	13:49	42°24,29'	10°02,26'	2608,6	16,6	35,800	4,0
# 13		15:30	42°33,00'	10°03,00'	2575,8	16,0	35,803	4,0
# 14		22:01	42°28,60'	9°18,93'	180,6	16,6	35,726	3,0
# 15	7.5.11	20:46	42°15,38'	9°49,49'	2330,3	16,2	35,850	3,0
# 16		22:42	42°16,27'	9°29,04'	844,8	16,5	35,879	3,0
# 17	8.5.11	01:23	42°34,16'	9°25,49'	251,8	16,1	35,742	2,75
# 18		07:50	42°23,09'	9°22,50'	315,4	16,2	35,740	3,0
# 19		13:38	42°38,73'	9°34,29'	763,4	15,7	35,752	3,0
# 20		17:20	42°45,20'	9°48,77'	2218,2	15,5	35,779	4,0
# 21		18:42	42°43,90'	9°59,97'	2577,5	15,1	35,846	2,5
# 22		22:04	42°17,30'	10°01,50'	2568,7	16,3	35,822	3,0
# 23		23:33	42°05,35'	10°01,50'	2504	16,1	35,837	3,0
# 24	9.5.11	01:19	41°59,90'	9°55,50'	2067,6	16,3	35,818	3,5
# 25		02:33	42°10,10'	9°55,50'	2483,2	16,3	35,847	4,0
# 26		10:00	42°05,03'	9°50,66'	2318,6	16,4	35,835	4,0
# 27		19:40	42°00,00'	9°32,83'	1666,1	16,7	35,911	3,5
# 28	10.5.11	23:11	42°31,46'	9°46,18'	2211,6	16,1	35,825	4,0
# 29	11.5.11	09:45	42°05,90'	9°31,00'	1404,9	16,5	35,823	4,0
PortStop	13.5.11							
# 30	13.5.11	18:38	42°13,00'	9°02,70'	121,5	17,7	35,457	2,5
# 31		19:39	42°13,00'	9°13,46'	176,2	17,2	35,547	2,5
# 32		22:05	42°15,98'	9°17,85'	212	16,8	35,520	2,0
# 33	14.5.11	10:30	42°14,46'	9°37,.20'	1885,8	16,3	35,870	3,0
# 34	15.5.11	01:10	42°07,00'	9°19,00'	206	16,3	35,660	2,5
# 35		04:23	42°06,80'	8°55,80'	64,2	14,7	35,850	3,0
# 36		09:57	42°01,56'	9°13,85'	145	15,6	35,687	2,5
# 37		11:24	42°01,57'	9°01,70'	111,2	14,7	35,855	2,0
# 38	16.5.11	15:14	42°07,00'	9°07,76'	142,1	16,0	35,656	2,5
# 39	17.5.11	21:46	42°21,46'	9°03,46'	109	16,1	35,579	2,0
# 40		23:56	42°29,81'	9°15,54'	128,7	16,4	35,556	2,5
# 41	22.5.11	22:10	42°22,29'	9°10,50'	141,2	15,8	35,498	2,0

Table 13: Niskin Bottle stations

GeoB No.	Ships station number	Date 2011	Gear	Gear Abbreviation	Time Sea floor (UTC)	Coordinates		Water Depth (m)
						Latitude	Longitude	
15606-1	ME844/357	04.05.11	Niskin Bottels	NIS	08:55	42° 26,21' N	9° 38,19' W	1660
15609-1	ME844/364	05.05.11	Niskin Bottels	NIS	05:26	42° 24,65' N	9° 47,35' W	1938
15613-3	ME844/376	07.05.11	Niskin Bottels	NIS	14:42	42° 27,05' N	10° 03,00' W	2641
15618-1	ME844/387	10.05.11	Niskin Bottels	NIS	22:45	42° 38,05' N	9° 53,67' W	2000
15623-3	ME844/461	19.05.11	Niskin Bottels	NIS	18:54	42° 04,35' N	9° 32,69' W	1620
15647-1	ME844/446	19.05.11	Niskin Bottels	NIS	09:20	42°07,022' N	8° 58,814' W	98,5
15653-1	ME844/454	19.05.11	Niskin Bottels	NIS	14:15	42°07,01' N	9° 08,54' W	144
15656-1	ME844/459	19.05.11	Niskin Bottels	NIS	17:21	42°06,991' N	9° 20,001' W	220
15657-1	ME844/465	20.05.11	Niskin Bottels	NIS	04:15	41°59,17' N	9° 25,67' W	1328
15663-1	ME844/483	21.05.11	Niskin Bottels	NIS	17:19	42°30,225' N	9° 15,711' W	125
15688-3	ME844/523	24.05.11	Niskin Bottels	NIS	07:52	42°24,709' N	9° 20,991' W	325

6 Ship's Meteorological Station: Weather Conditions during M84/4

(Hartmut Sonnabend, Deutscher Wetterdienst)

RV METEOR left the harbor of Vigo on 01.05.2011 at 9 o'clock in the morning. The synoptic situation at this time was characterized by a flat trough covering the areas from Brittany over Northwest Spain towards the Canary Islands. Due to this constellation soft to moderate winds from northeast and a northwesterly swell of about 2,5 meters dominated the first working day at sea. This trough moved to the Central Mediterranean Sea soon and was followed by a ridge of high pressure. The wind shifted to northwest and increased for while up to force 5 to 6 Beaufort during afternoon and evening of 2.5., while the northwesterly swell remained essentially. Under high pressure conditions the weather became fine with soft winds from southwest during the following day and also the swell flattened down to 1,5 meters.

At same time an extensive storm depression developed over the Central North Atlantic and became stationary for a while at about 50°North/27°West with a minimum air pressure of 986 hPa. The swell which was induced by this system reached the working area of RV METEOR during 4.5. with an height of about 3 meters by average. The wind shifted to southwest to south and increased to Beaufort 6 in the afternoon of 5.5., causing a wind sea of 1,5 – 2 meters which crossed the still persisting westnorthwesterly swell of around 3 meters. The next day brought only little change to these conditions.

Until the following weekend a large new storm depression arrived over the central East Atlantic. In the evening of 7.5. it reached a position of 49°North/18°West with a minimum air pressure of 978 hPa and started to track from there towards the sea areas west or Ireland very slowly. During the approach of its coldfront in the afternoon and evening of 7.5., the wind increased to force 8 Beaufort, gusting up to force 9 from south to southwest associated with some heavy rain showers and a rough wind sea reaching 3,5 meter for a while. After a short post frontal break the wind soon increased again during the following night to southwest 6 – 7 Beaufort. The waves which had been produced in the southern flank of this storm depression reached the working area off the coasts of Galicia in the morning of 8.5. as an impressive swell from westnorthwest growing up to 4 – 5 meters until the evening of the same day. As the wind remained southwesterly around force 6 Beaufort the sea state became rather uncomfortable, impeding the working program.

Until the following day steadily rising air pressure had formed a small high pressure ridge which was connected with a high east of Newfoundland and another Anticyclone over the central Baltic Sea. Within its axis the weather became fine and the wind decreased to nearly calm conditions for a while. The northwesterly swell however remained high and flattened down very slowly from 4 meters in the morning to 3 – 3,5 meters in the evening. At same time a flat low centered over Marocco spread towards Spain and Portugal and pressed the axis of the high pressure belt a little bit northward forming a strong air pressure gradient over the working area. The wind shifted to northerly directions and increased soon reaching force 6 – 7 Beaufort in the early morning of 10.05. and Beaufort 7 to gale force 8 in the afternoon and evening of the same day. A rough wind sea was induced with maximum wave heights of 3 – 3,5 meters and in combination with the still existing northwesterly swell of around 2,5 meters, the sea state became rather uncomfortable again. As the synoptic situation with strong winds persisted until noon of 12.5., the northwesterly swell flattened more and more loosing its meaning as significant disruptive element in the meantime. In the course of this day the wind started to decrease and became soft to moderate from north to northwest during the following night, when RV METEOR headed for the mouth of the Ria de Vigo. On 13.5. the working program at sea was interrupted by a short stay in the harbor of Vigo.

In the meantime a new large high with an air pressure of about 1035 hPa had established over the central East Atlantic. Its strong ridge extending across the Biscay towards France formed a sharp air pressure gradient in opposite to the flat low over the Iberian Peninsula. Soon after having left the Ria de Vigo the wind shifted to northerly directions increasing rapidly to force 7 Beaufort and up to 8 Beaufort until the morning of 14.5. Once more a rough wind sea of about 3 meters developed. After a short break with force 6 – 7 Beaufort during daytime, the wind increased to force 8 from northnortheast in the evening of the same day and reaching a new maximum of force 9 Beaufort before midnight. The sea became very rough and the wave heights rose up to 4 meters. Heading towards the coast the weather conditions and the sea state improved gradually during the second part of the night. In the morning of 15.05., when RV METEOR arrived right in front of the coast just a little bit south of the Ria de Vigo, the weather became fine with moderate to fresh winds from north to northeast and blue skies. The next increase of wind was not as powerful as the days before, reaching force 6 – 7 in the evening of the same day and first part of the night. During the following 2 days generally fine weather conditions predominated with a gentle to moderate breeze from mainly northerly directions.

Between a flat through extending from the Strait of Gibraltar towards Northern Portugal and a ridge of the North Atlantic subtropical high west of the working area, the northerly airflow speeded up gradually, reaching force 6 – 7 Beaufort in the evening of 18.05. The next morning however, only a few miles off the coast, brought favorable conditions again with moderate to fresh northerly winds. But a long termed swell from the northwest with heights of around 2,5 to 3 meters reached the working area in the early afternoon of this day, causing rather uncomfortable conditions in combination with the every evening increase of the wind up to Beaufort 6 – 7 from north to northwest. As the location of the next day working area was in some distance to the coastline the wind remained fresh to strong during the whole day. Back to the coast again the 21.05. brought the obligatory change between favorable conditions from morning until noon and a sharp rise of wind speed during afternoon and evening. No such significant amplitude was recorded next day when the northerly wind kept with force 5 – 6 and later on Beaufort 6 – 7 on a relative high level and a new swell from the northwest with heights up to 3 meters reached the working area during the night to 23.05. A short break until noon of this day with gentle winds from the north was followed soon by the next strong wind event lasting from early evening until morning of 24.05., when the wind calmed down to force 3 during station work near the coast. The following PARASOUND Profile however, carried out in some distance of the coast was affected by strong northerly winds up to force 7 at times and a rough sea. Next morning, when working along the coastline, the weather returned to fine and calm conditions.

But this didn't last for long time because the air pressure gradient between a new strong high located over the central East Atlantic and the constant flat trough over the Iberian Peninsula started to strengthen again. This constellation meant a period with strong to stormy winds from northerly to northeasterly directions for the final part of this cruise, starting in the afternoon of 25.05. and lasting until noon of 27.05. Especially in the early morning of this day gale force 8 with gusts up to Beaufort 9 were measured for some hours. In combination with a rough wind sea, which fortunately was blocked at times by the nearby land, a long termed swell from Nnorthnorthwest of around 3 meters caused one more time uncomfortable pitching and rolling of the ship. From noon of this day wind and sea conditions started to improve gradually and fresh to strong winds from north to northeast dominated the last hours of this cruise. In the morning 28.05. RV METEOR put into the harbor of Vigo.

7 Station List M84/4

7.1 List of Station Data

GeoB No.	Ships station number	Date 2011	Gear	Gear Abbreviation	Time Sea floor (UTC)	Coordinates		Water Depth (m)
						Latitude	Longitude	
15601-1	ME844/351	02.05.11	Gaint Box Corer	GBC	7:48	42° 05,39' N	9° 24,82' W	867
15602-1	ME844/352	02.05.11	Gaint Box Corer	GBC	09:03	42° 05,19' N	9° 26,38' W	1092
15603-1	ME844/353	02.05.11	Gaint Box Corer	GBC	10:33	42° 04,89' N	9° 28,60' W	1426
15604-1	ME844/354	02.05.11	Gaint Box Corer	GBC	12:18	42° 04,79' N	9° 30,01' W	1598
15605-1	ME844/356	04.05.11	Gaint Box Corer	GBC	06:27	42° 30,58' N	9° 30,45' W	1524
15606-1	ME844/357	04.05.11	Niskin Bottels	NIS	08:55	42° 26,21' N	9° 38,19' W	1660
15606-2	ME844/358	04.05.11	Multi Corer	MUC	09:46	42° 26,21' N	9° 38,21' W	1656
15606-3	ME844/359	04.05.11	Gravity Corer	GC-6	11:44	42° 26,21' N	9° 38,21' W	1655
15607-1	ME844/360	04.05.11	Gaint Box Corer	GBC	13:54	42° 28,53' N	9° 39,39' W	1883
15607-2	ME844/361	04.05.11	Gravity Corer	GC-6	15:48	42° 28,53' N	9° 39,39' W	1883
15608-1	ME844/362	04.05.11	Gaint Box Corer	GBC	18:00	42° 30,20' N	9° 40,23' W	2043
15609-1	ME844/364	05.05.11	Niskin Bottels	NIS	05:26	42° 24,65' N	9° 47,35' W	1938
15609-2	ME844/365	05.05.11	Multicorer	MUC	06:30	42° 24,65' N	9° 47,35' W	1935
15609-3	ME844/366	05.05.11	Gravity Corer	GC-6	08:37	42° 24,65' N	9° 47,35' W	1935
15610-1	ME844/367	05.05.11	Gravity Corer	GC-6	10:58	42° 23,12' N	9° 52,26' W	2214
15610-2	ME844/368	05.05.11	Multicorer	MUC	12:54	42° 23,12' N	9° 52,26' W	2215
15611-1	ME844/369	05.05.11	Gaint Box Corer	GBC	16:01	42° 32,28' N	9° 53,12' W	2420
15611-2	ME844/373	05.05.11	Gravity Corer	GC-6	07:49	42° 32,27' N	9° 53,10' W	2415
15612-1	ME844/370	05.05.11	Gaint Box Corer	GBC	18:11	42° 31,87' N	9° 53,08' W	2359
15612-2	ME844/371	05.05.11	Gravity Corer	GC-3	20:37	42° 31,88' N	9° 53,09' W	2359
15613-1	ME844/374	07.05.11	Gravity Corer	GC-12	11:06	42° 27,05' N	10° 03,00' W	2639
15613-2	ME844/375	07.05.11	Multicorer	MUC	13:20	42° 27,05' N	10° 03,00' W	2639
15613-3	ME844/376	07.05.11	Niskin Bottels	NIS	14:42	42° 27,05' N	10° 03,00' W	2641
15614-1	ME844/379	10.05.11	Multicorer	MUC	04:26	42° 23,08' N	9° 36,64' W	1029
15614-2	ME844/386	10.05.11	Gaint Box Corer	GBC	18:53	42° 23,08' N	9° 36,63' W	1028
15615-1	ME844/380	10.05.11	Multicorer	MUC	06:41	42° 22,23' N	9° 42,70' W	1709
15615-2	ME844/385	10.05.11	Gravity Corer	GC-12	16:34	42° 22,22' N	9° 42,70' W	1708
15616-1	ME844/381	10.05.11	Gaint Box Corer	GBC	08:34	42° 22,34' N	9° 42,31' W	1792
15616-2	ME844/384	10.05.11	Gravity Corer	GC-6	14:36	42° 22,34' N	9° 42,31' W	1794
15617-1	ME844/382	10.05.11	Gaint Box Corer	GBC	10:22	42° 22,49' N	9° 41,72' W	1860
15617-2	ME844/383	10.05.11	Gravity Corer	GC-6	12:25	42° 22,49' N	9° 41,72' W	1859
15618-1	ME844/387	10.05.11	Niskin Bottels	NIS	22:45	42° 38,05' N	9° 53,67' W	2000
15618-2	ME844/388	11.05.11	Multicorer	MUC	00:10	42° 38,05' N	9° 53,66' W	2000
15618-3	ME844/389	11.05.11	Gravity Corer	GC-12	02:30	42° 38,05' N	9° 53,66' W	2000
15619-1	ME844/390	11.05.11	Gravity Corer	GC-6	05:32	42° 33,08' N	9° 53,21' W	2356
15619-2	ME844/391	11.05.11	Multicorer	MUC	07:41	42° 33,08' N	9° 53,21' W	2359
15620-1	ME844/392	11.05.11	Multicorer	MUC	11:07	42° 28,66' N	9° 35,16' W	1625
15620-2	ME844/393	11.05.11	Gravity Corer	GC-12	13:02	42° 28,66' N	9° 35,16' W	1625
15621-1	ME844/394	11.05.11	Gravity Corer	GC-6	15:01	42° 27,86' N	9° 35,18' W	1740
15621-2	ME844/395	11.05.11	Multicorer	MUC	16:51	42° 27,88' N	9° 35,19' W	1742
15622-1	ME844/396	11.05.11	Multicorer	MUC	18:50	42° 28,61' N	9° 30,64' W	1472
15622-2	ME844/397	11.05.11	Gravity Corer	GC-12	21:04	42° 28,61' N	9° 30,64' W	1471

GeoB No.	Ships station number	Date 2011	Gear	Gear Abbreviation	Time Sea floor (UTC)	Coordinates		Water Depth (m)
15623-1	ME844/399	12.05.11	Gaint Box Corer	GBC	09:30	42° 04,35' N	9° 32,65' W	1617
15623-2	ME844/400	12.05.11	Gravity Corer	GC-6	11:21	42° 04,35' N	9° 32,65' W	1619
15623-3	ME844/461	19.05.11	Niskin Bottels	NIS	18:54	42° 04,35' N	9° 32,69' W	1620
15623-4	ME844/462	19.05.11	Giant Box Corer	GBC	19:40	42° 04,34' N	9° 32,69' W	1616
15624-1	ME844/401	12.05.11	Gravity Corer	GC-6	13:14	42° 03,97' N	9° 32,58' W	1639
15624-2	ME844/463	19.05.11	Giant Box Corer	GBC	21:11	42° 03,94' N	9° 32,66' W	1636
15625-1	ME844/402	12.05.11	Gravity Corer	GC-6	14:58	42° 04,81' N	9° 30,02' W	1598
15626-1	ME844/403	12.05.11	Gravity Corer	GC-6	16:37	42° 05,20' N	9° 26,39' W	1089
15627-1	ME844/406	14.05.11	Multicorer	MUC	05:11	42° 15,49' N	9° 35,64' W	1903
15628-1	ME844/407	14.05.11	Multicorer	MUC	07:20	42° 15,21' N	9° 38,20' W	1961
15628-2	ME844/412	14.05.11	Gravity Corer	GC-12	17:58	42° 15,21' N	9° 38,20' W	1965
15629-1	ME844/408	14.05.11	Multicorer	MUC	09:19	42° 14,47' N	9° 37,20' W	1885
15629-2	ME844/407	14.05.11	Gravity Corer	GC-6	15:48	42° 14,47' N	9° 37,19' W	1885
15630-1	ME844/409	14.05.11	Gaint Box Corer	GBC	11:45	42° 13,81' N	9° 35,35' W	1891
15630-2	ME844/410	14.05.11	Gravity Corer	GC-6	13:43	42° 13,81' N	9° 35,35' W	1891
15631-1	ME844/415	15.05.11	Multicorer	MUC	13:13	41° 54,90' N	9° 02,42' W	102
15631-2	ME844/420	15.05.11	Gravity Corer	GC-3	16:26	41° 54,91' N	9° 02,42' W	101
15632-1	ME844/416	15.05.11	Multicorer	MUC	13:40	41° 55,40' N	9° 02,42' W	103
15632-2	ME844/419	15.05.11	Gravity Corer	GC-3	15:52	41° 55,41' N	9° 02,42' W	103
15633-1	ME844/417	15.05.11	Multicorer	MUC	14:23	41° 58,41' N	9° 02,43' W	110
15633-2	ME844/418	15.05.11	Gravity Corer	GC-3	15:03	41° 58,41' N	9° 02,43' W	109
15634-1	ME844/430	18.05.11	Gaint Box Corer	GBC	18:41	42° 06,99' N	9° 16,74' W	179
15635-1	ME844/431	18.05.11	Gaint Box Corer	GBC	19:42	42° 06,97' N	9° 11,80' W	160
15636-1	ME844/432	18.05.11	Grab Sampler	GS	20:36	42° 06,99' N	9° 09,35' W	147
15637-1	ME844/433	18.05.11	Grab Sampler	GS	21:07	42° 07,01' N	9° 07,96' W	143
15638-1	ME844/434	18.05.11	Grab Sampler	GS	21:36	42° 07,01' N	9° 06,85' W	141
15639-1	ME844/435	18.05.11	Multicorer	MUC	22:11	42° 07,01' N	9° 05,46' W	135
15640-1	ME844/436	18.05.11	Multicorer	MUC	23:08	42° 07,00' N	9° 04,07' W	132
15641-1	ME844/437	19.05.11	Multicorer	MUC	00:08	42° 07,00' N	9° 02,67' W	128
15642-1	ME844/438	19.05.11	Multicorer	MUC	01:08	42° 07,00' N	8° 59,71' W	110
15643-1	ME844/439	19.05.11	Multicorer	MUC	02:12	42° 07,00' N	8° 58,81' W	105
15644-1	ME844/440	19.05.11	Multicorer	MUC	03:47	41° 55,01' N	9° 00,00' W	87
15644-2	ME844/445	19.05.11	Gravity Corer	GC-6	07:38	41° 55,02' N	9° 00,01' W	83
15645-1	ME844/441	19.05.11	Multicorer	MUC	04:30	41° 55,01' N	9° 04,01' W	117
15645-2	ME844/444	19.05.11	Gravity Corer	GC-6	06:48	41° 55,01' N	9° 04,00' W	116
15646-1	ME844/442	19.05.11	Multicorer	MUC	05:15	41° 55,00' N	9° 06,01' W	122
15646-2	ME844/443	19.05.11	Gravity Corer	GC-6	06:05	41° 55,00' N	9° 06,01' W	122
15647-1	ME844/446	19.05.11	Niskin Bottels	NIS	09:20	42°07,022' N	8° 58,814' W	98,5
15648-1	ME844/447	19.05.11	Rumohr Corer	RC	10:03	42°07,011' N	9° 01,494' W	115,7
15648-2	ME844/448	19.05.11	Rumohr Corer	RC	10:29	42°07,012' N	9° 01,495' W	115,7
15648-3	ME844/449	19.05.11	Rumohr Corer	RC	10:43	42°07,014' N	9° 01,493' W	116,2
15649-1	ME844/450	19.05.11	Rumohr Corer	RC	11:25	42°07,00' N	9° 03,43' W	126
15650-1	ME844/451	19.05.11	Rumohr Corer	RC	12:15	42°06,999' N	9° 04,386' W	129,9
15651-1	ME844/452	19.05.11	Rumohr Corer	RC	12:58	42°07,00' N	9° 05,96' W	135
15652-1	ME844/453	19.05.11	Rumohr Corer	RC	13:35	42°07,00' N	9° 07,05' W	138
15653-1	ME844/454	19.05.11	Niskin Bottels	NIS	14:15	42°07,01' N	9° 08,54' W	144
15653-2	ME844/455	19.05.11	Rumohr Corer	RC	14:47	42°07,01' N	9° 08,54' W	144
15654-1	ME844/456	19.05.11	Rumohr Corer	RC	15:21	42°07,00' N	9° 10,55' W	149,8

GeoB No.	Ships station number	Date 2011	Gear	Gear Abbreviation	Time Sea floor (UTC)	Coordinates		Water Depth (m)
15654-2	ME844/457	19.05.11	Rumohr Corer	RC	15:35	42°07,004' N	9° 10,556' W	149,8
15655-1	ME844/458	19.05.11	Rumohr Corer	RC	16:08	42°07,007' N	9° 12,229' W	160
15656-1	ME844/459	19.05.11	Niskin Bottels	NIS	17:21	42°06,991' N	9° 20,001' W	220,8
15656-2	ME844/460	19.05.11	Rumohr Corer	RC	17:30	42°06,991' N	9° 20,002' W	220,5
15657-1	ME844/465	20.05.11	Niskin Bottels	NIS	04:15	41°59,17' N	9° 25,67' W	1328,5
15657-1	ME844/466	20.05.11	Giant Box Corer	GBC	05:08	41°59,177' N	9° 25,649' W	1327,8
15657-2	ME844/474	20.05.11	Gravity Corer	GC-6	18:27	41°59,198' N	9° 25,629' W	1327,6
15657-3	ME844/475	20.05.11	Gravity Corer	GC-2.5	19:51	41°59,200' N	9° 25,629' W	1326,9
15658-1	ME844/467	20.05.11	Giant Box Corer	GBC	06:36	41°58,731' N	9° 26,660' W	1389,4
15658-2	ME844/473	20.05.11	Gravity Corer	GC-6	16:45	41°58,726' N	9° 26,650' W	1393,6
15659-1	ME844/468	20.05.11	Giant Box Corer	GBC	08:17	41°59,200' N	9° 27,927' W	1406,2
15659-2	ME844/472	20.05.11	Gravity Corer	GC-6	15:05	41°59,184' N	9° 27,916' W	1406,3
15660-1	ME844/470	20.05.11	Giant Box Corer	GBC	11:21	41°58,980' N	9° 28,681' W	1402,8
15660-2	ME844/471	20.05.11	Gravity Corer	GC-12	13:00	41°58,980' N	9° 28,681' W	1402,9
15661-1	ME844/479	21.05.11	Giant Box Corer	GBC	12:40	42°20,248' N	9° 12,022' W	145
15661-2	ME844/482	21.05.11	Vibro Corer	VC	15:24	42°20,244' N	9° 12,025' W	146,02
15662-1	ME844/480	21.05.11	Giant Box Corer	GBC	13:22	42°21,267' N	9° 12,403' W	150,8
15662-2	ME844/481	21.05.11	Vibro Corer	VC	14:26	42°21,268' N	9° 12,403' W	151,8
15663-1	ME844/483	21.05.11	Niskin Bottels	NIS	17:19	42°30,225' N	9° 15,711' W	125
15663-2	ME844/484	21.05.11	Giant Box Corer	GBC	17:52	42°30,224' N	9° 15,711' W	126
15664-1	ME844/488	23.05.11	Rumohr Corer	RC	07:12	42°04,255' N	9° 08,800' W	139,6
15665-1	ME844/489	23.05.11	Rumohr Corer	RC	07:53	42°04,255' N	9° 06,245' W	132,5
15666-1	ME844/490	23.05.11	Rumohr Corer	RC	08:27	42°04,249' N	9° 04,673' W	130
15667-1	ME844/491	23.05.11	Rumohr Corer	RC	08:55	42°04,253' N	9° 04,456' W	129
15668-1	ME844/492	23.05.11	Rumohr Corer	RC	09:27	42°04,231' N	9° 03,887' W	126
15669-1	ME844/493	23.05.11	Rumohr Corer	RC	09:58	42°04,255' N	9° 03,630' W	125
15670-1	ME844/494	23.05.11	Rumohr Corer	RC	10:36	42°04,24' N	9° 02,889'W	122,7
15671-1	ME844/495	23.05.11	Rumohr Corer	RC	11:21	42°04,244' N	9° 00,176' W	104,6
15672-1	ME844/496	23.05.11	Rumohr Corer	RC	12:13	42°09,997' N	8° 59,028' W	102
15672-2	ME844/497	23.05.11	Gravity Corer	GC-6	12:48	42°09,998' N	8° 59,027' W	103,4
15673-1	ME844/498	23.05.11	Gravity Corer	GC-6	13:44	42°12,998' N	9° 00,679' W	111,5
15673-2	ME844/499	23.05.11	Rumohr Corer	RC	14:18	42°12,998' N	9° 00,680' W	112,1
15674-1	ME844/500	23.05.11	Rumohr Corer	RC	15:00	42°15,990' N	8° 58,864' W	95,5
15675-1	ME844/501	23.05.11	Rumohr Corer	RC	15:34	42°16004' N	9° 02,290' W	116,5
15675-2	ME844/502	23.05.11	Rumohr Corer	RC	15:49	42°16,004' N	9° 02,290' W	117,3
15676-1	ME844/503	23.05.11	Rumohr Corer	RC	16:18	42°15,998' N	9° 04,277' W	123,9
15677-1	ME844/504	23.05.11	Rumohr Corer	RC	17:05	42°19,012' N	9° 00,033' W	95,3
15678-1	ME844/505	23.05.11	Rumohr Corer	RC	17:41	42°18,993' N	9° 01,486' W	106,9
15679-1	ME844/506	23.05.11	Rumohr Corer	RC	18:18	42°20,334' N	9° 02,920' W	112
15679-2	ME844/554	27.05.11	Gravity Corer	GC-6	11:59	42°20,33' N	9° 02,920' W	112
15680-1	ME844/507	23.05.11	Rumohr Corer	RC	19:05	42°19,007' N	9° 07,002' W	135
15681-1	ME844/508	23.05.11	Rumohr Corer	RC	19:45	42°18,524' N	9° 09,999' W	143
15682-1	ME844/509	23.05.11	Rumohr Corer	RC	20:15	42°18,798' N	9° 10,457' W	145
15683-1	ME844/510	23.05.11	Rumohr Corer	RC	21:13	42°20,840' N	9° 09,041' W	138,6
15683-2	ME844/529	24.05.11	Vibro Corer	VC	07:18	42°20,846' N	9° 09,013' W	138,2
15683-3	ME844/530	24.05.11	Vibro Corer	VC	07:58	42°20,845' N	9° 09,014' W	138,5
15684-1	ME844/511	23.05.11	Rumohr Corer	RC	22:18	42°27,689' N	9° 06,512' W	97,7
15684-2	ME844/531	24.05.11	Vibro Corer	VC	09:16	42°27,719' N	9° 06,545' W	98,5

GeoB No.	Ships station number	Date 2011	Gear	Gear Abbreviation	Time Sea floor (UTC)	Coordinates		Water Depth (m)
15685-1	ME844/512	23.05.11	Rumohr Corer	RC	23:30	42°28,303' N	9° 10,502' W	114,3
15685-2	ME844/524	24.05.11	Gravity Corer	GC-3	09:11	42°28,32' N	9° 10,510' W	114,3
15685-3	ME844/534	24.05.11	Vibro Corer	VC	12:22	42°28,303' N	9° 10,501' W	114
15686-1	ME844/513	23.05.11	Rumohr Corer	RC	23:59	42°28,849' N	9° 10,500' W	109,7
15686-2	ME844/525	24.05.11	Gravity Corer	GC-3	09:40	42°28,86' N	9° 10,500' W	111,2
15686-3	ME844/533	24.05.11	Vibro Corer	VC	11:19	42°28,851' N	9° 10,496' W	111
15687-1	ME844/514	24.05.11	Rumohr Corer	RC	00:25	42°29,297' N	9° 10,502' W	100,6
15687-2	ME844/526	24.05.11	Grab Sampler	GS	10:23	42°29,311' N	9° 10,502' W	100,4
15687-3	ME844/527	24.05.11	Gravity Corer	GC-3	10:46	42°29,310' N	9° 10,501' W	100,8
15687-4	ME844/532	24.05.11	Vibro Corer	VC	10:30	42°29,302' N	9° 10,503' W	101
15688-1	ME844/515	24.05.11	Rumohr Corer	RC	01:59	42°24,641' N	9° 21,000' W	328,3
15688-2	ME844/522	24.05.11	Gravity Corer	GC-12	07:10	42°24,651' N	9° 21,008' W	326
15688-3	ME844/523	24.05.11	Niskin Bottels	NIS	07:52	42°24,709' N	9° 20,991' W	325
15689-1	ME844/516	24.05.11	Rumohr Corer	RC	02:53	42°27,099' N	9° 21,005' W	300,4
15690-1	ME844/517	24.05.11	Rumohr Corer	RC	03:32	42°27,633' N	9° 19,711' W	251,9
15691-1	ME844/518	24.05.11	Rumohr Corer	RC	04:12	42°26,862' N	9° 19,715' W	275,3
15692-1	ME844/519	24.05.11	Rumohr Corer	RC	04:55	42°26,332' N	9° 21,002' W	324,8
15693-1	ME844/520	24.05.11	Rumohr Corer	RC	05:30	42°25,700' N	9° 21,841' W	220
15693-2	ME844/521	24.05.11	Rumohr Corer	RC	05:55	42°25,700' N	9° 21,840' W	350,5
15694-1	ME844/536	25.05.11	Rumohr Corer	RC	20:10	42°29,13' N	9° 15,330' W	134,1
15695-1	ME844/537	25.05.11	Rumohr Corer	RC	20:43	42°28,508' N	9° 15,073' W	139,8
15696-1	ME844/538	25.05.11	Rumohr Corer	RC	21:09	42°28,226' N	9° 14,991' W	136,8
15697-1	ME844/539	25.05.11	Rumohr Corer	RC	21:46	42°27,098' N	9° 14,588' W	144,9
15698-1	ME844/540	25.05.11	Rumohr Corer	RC	22:30	42°26,41' N	9° 14,310' W	150,4
15699-1	ME844/541	25.05.11	Rumohr Corer	RC	23:19	42°24,576' N	9° 13,636' W	148,9
15801-1	ME844/542	25.05.11	Rumohr Corer	RC	00:01	42°24,221' N	9° 13,507' W	152,9
15802-1	ME844/543	25.05.11	Rumohr Corer	RC	00:50	42°22,622' N	9° 12,918' W	153,8
15803-1	ME844/544	25.05.11	Rumohr Corer	RC	01:42	42°19,921' N	9° 11,933' W	151,2
15804-1	ME844/545	25.05.11	Rumohr Corer	RC	02:36	42°15,207' N	9° 12,550' W	159,8
15804-2	ME844/546	25.05.11	Rumohr Corer	RC	02:51	42°15,208' N	9° 12,551' W	160,1
15805-1	ME844/547	25.05.11	Rumohr Corer	RC	03:25	42°13,297' N	9° 12,824' W	170,1
15806-1	ME844/548	25.05.11	Rumohr Corer	RC	04:26	42°06,452' N	9° 13,779' W	159,8
15807-1	ME844/549	25.05.11	Rumohr Corer	RC	05:22	42°00,572' N	9° 14,599' W	147,4
15808-1	ME844/550	25.05.11	Rumohr Corer	RC	07:02	42°10,01' N	9° 09,850' W	147,1
15809-1	ME844/551	25.05.11	Rumohr Corer	RC	07:41	42° 10,02' N	9° 13,040' W	170,8

7.2 Documentation of Coring-Site Selection Strategy

7.2.1 Justification of the Individual Sites

For a better understanding and reproduction of the motivation why an individual core location was chosen, the following table lists information about:

1) The general morphological conditions at the site location;

2) a brief description of the local strata appearance, mainly based on PARASOUND data;

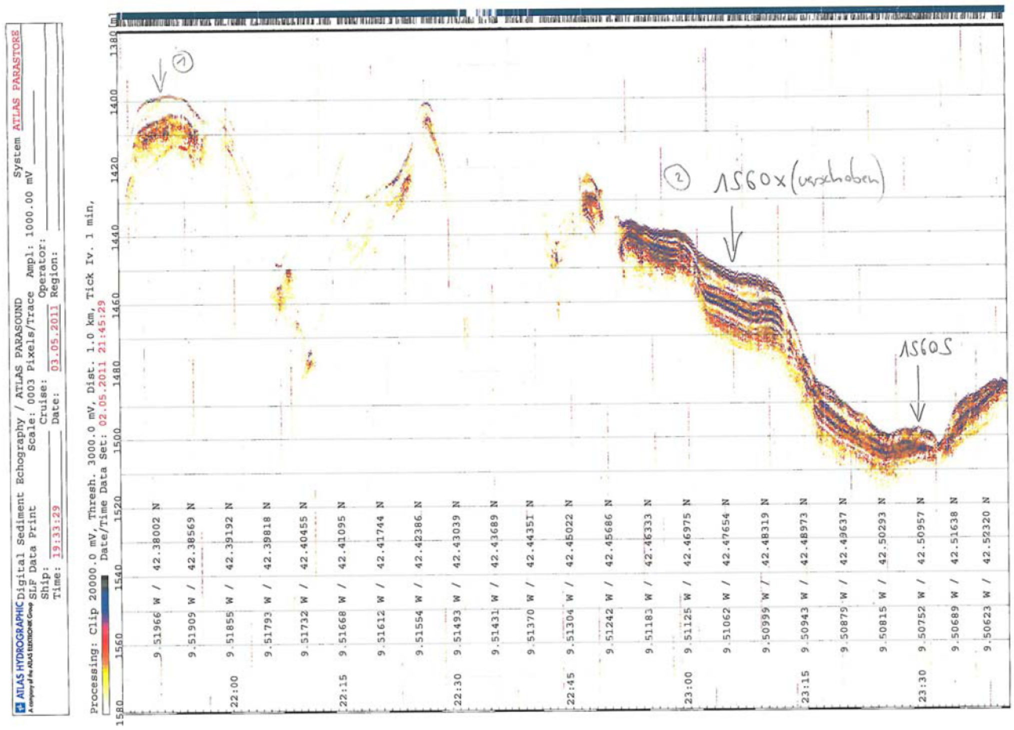
3) the scientific motivation of taking a core there.

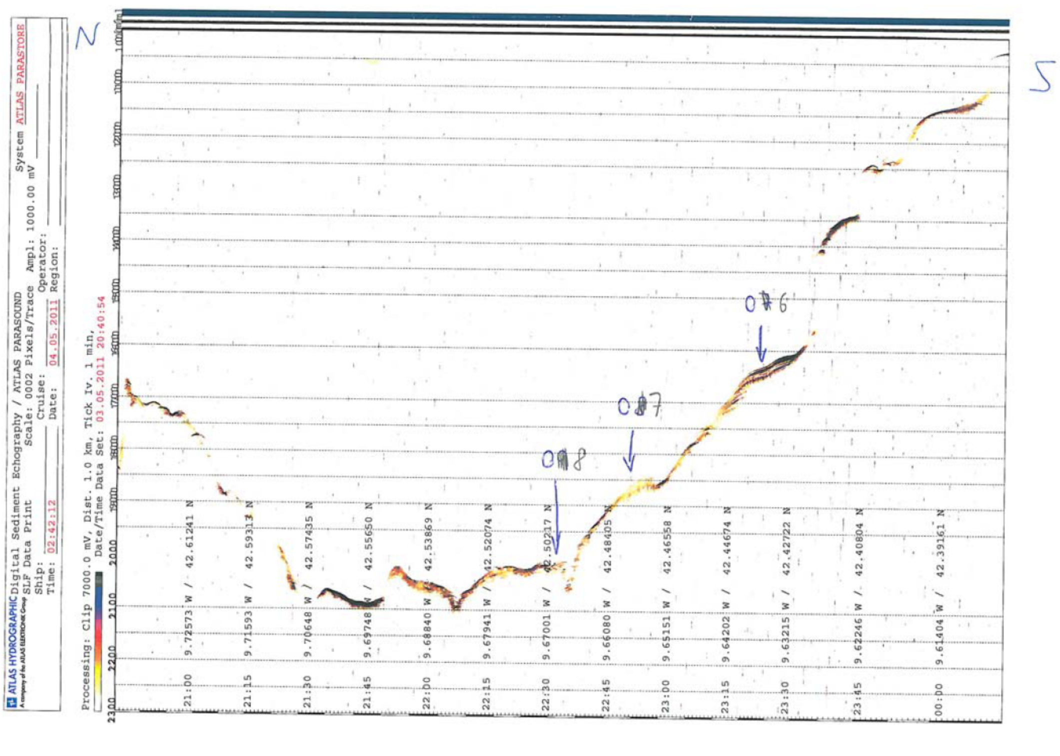
Core	Area	Local settings	Scientific intension
15601	Gully at 42°05' (middle position)	Gully entrance	Gully activity, shelf export dynamics
15602	Gully at 42°05' (middle position) (same as 15626)	Mid-course terrace inside gully, thalweg or terrace?	Gully activity, shelf export dynamics
15603	Gully at 42°05' (middle position)	Mid-course widening of gully	Gully activity, shelf export dynamics
15604	Gully at 42°05' (middle position) (same as 15625)	deposits in thalweg at exit of gully	Gully activity, shelf export dynamics
15605	Canyon system north of mount, off Arousa, upper part	Blocky material inside thalweg	Activity of canyon system, shelf export dynamics, downslope transport patterns
15606	Canyon system north of mount, off Arousa, upper part	Stratified sediments of elevated terrace in "theatre" exit	Activity of canyon system, shelf export dynamics, downslope transport patterns
15607	Canyon system north of mount, off Arousa, upper part	Stratified sediments of elevated terrace in "theatre" exit, located a bit deeper than 15606	Activity of canyon system, shelf export dynamics, downslope transport patterns
15608	Canyon system north of mount, off Arousa, upper part	Thalweg of main channel	Activity of canyon system, shelf export dynamics, downslope transport patterns
15609	Distal "end" (?) of contourite	Highest elevation of this contourite feature, thinning and draping of stratified deposits	Role of deep currents, sediment transport and distribution
15610	Basin fill	Contouritic (?) stratified basin deposit, maximum accumulation center	Role of deep currents, reference material from basin
15611	Main channel system	Thalweg with stratified (?) deposits	Role of channel system, far distance sediment transport and sorting
15612	Main channel system	Side flank, strong reflecting strata	Role of channel system, far distance sediment transport and sorting
15613	Central basin	Thick stratified deposits, ypical basin fill, hemipelagic	Undisturbed reference material
15614	Mount-like structural height	Top sediments	Local source of deposits, current influence
15615	Contourite next to mount	Crest of contourite, nice stratified deposits	Current transport, sediment distribution patterns
15616	Contourite next to mount	Terrace inside moat, half-way to crest, stratified?	Current transport, sediment distribution patterns
15617	Contourite next to mount	Base of moat, debritic	Current transport, sediment distribution patterns
15618	Contouritic (?) ridge N of the main channel system, far offshore	Stratified deposits condensed, overlying older units, contouritic?	Origin of offshore deposits, role of ocean currents in sediment distribution
15619	Distal part of main channel system	N' flank of channel, debritic slide, typical for the N' flank setting	Transport modes
15620	Canyon system north of	Side terrace/levee with stratified sedi-	Activity of canyon system, shelf export

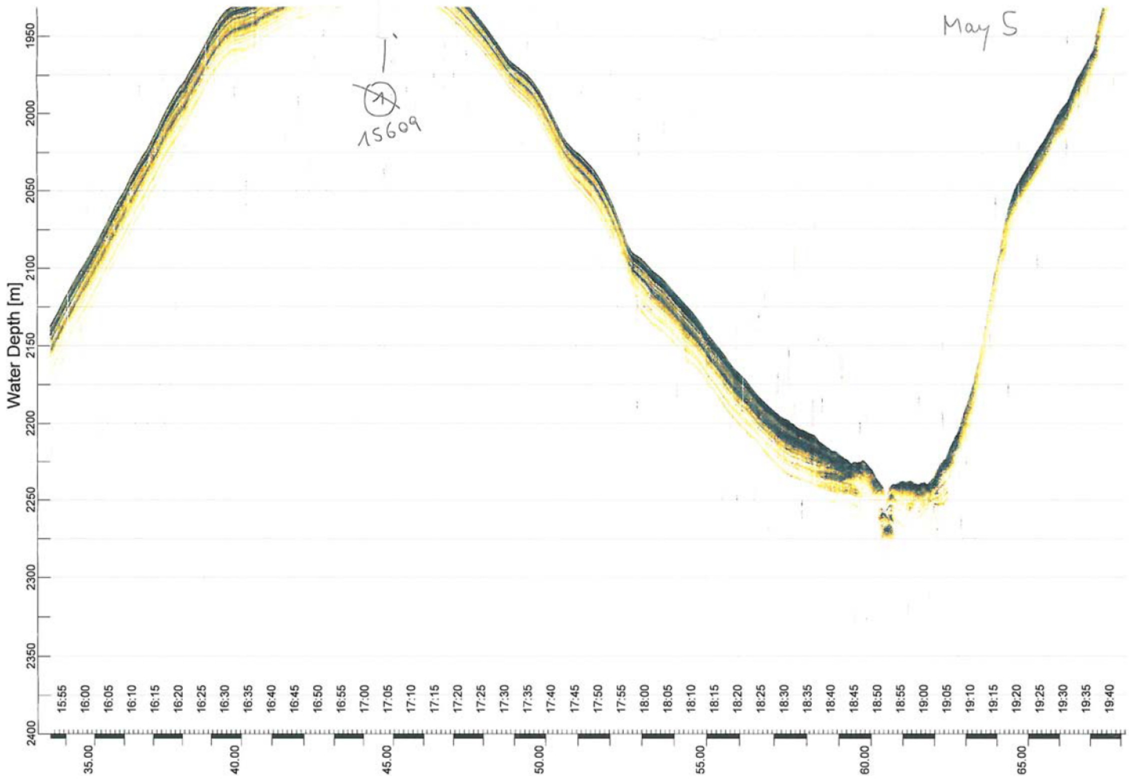
	mount, off Arousa, upper part, side terrace	ments, turbiditic?	dynamics, downslope transport patterns
15621	Canyon system north of mount, off Arousa, upper part, side terrace	Canyon thalweg, chaotic facies	Activity of canyon system, shelf export dynamics, downslope transport patterns
15622	Canyon system north of mount, off Arousa, uppermost part, side terrace	Terrace, thick stratified deposit draping the relief	Canyon activity, downslope transport dynamics, first depocenter off the shelf break
15623	Gully at 42°05' (middle position)	Slightly elevated "ridge" in front of the gully, stratified deposits, contouritic?	Gully activity, shelf export dynamics
15624	Gully at 42°05' (middle position)	Local depression fill in the gully mouth, debritic	Gully activity, shelf export dynamics, pathway into the basin
15625	Gully at 42°05' (middle position) (same as GeoB 15604)	deposits in thalweg at exit of gully	Gully activity, shelf export dynamics
15626	Gully at 42°05' (middle position) (same station as GeoB 15602)	Mid-course terrace inside gully, thalweg or terrace?	Gully activity, shelf export dynamics
15627	Gully at 42°15' (northern position, S of mount)	Slightly stratified deposits on terrace in the middle run of the gully	Gully activity, shelf export dynamics, most proximal depocenter off the shelf break
15628	Gully at 42°15' (northern position, S of mount)	Nicely stratified deposits in local "basin" in front of the gully mouth	Gully activity, shelf export dynamics, most proximal depocenter at the slope
15629	Gully at 42°15' (northern position, S of mount)	Slightly elevated "ridge" in front of the gully mouth, contouritic (?) stratified	Gully activity, shelf export dynamics
15630	Gully at 42°15' (northern position, S of mount)	Local depression fill inside the gully mouth, debritic	Gully activity, shelf export dynamics
15631	Inner shelf S of Ría de Vigo	Mudbelt, 0.5 nm S of ship wreck	Sediment transport, effect of bottom trawling, current upstream
15632	Inner shelf S of Ría de Vigo	Mudbelt, 250 m W of ship wreck	Sediment transport, effect of bottom trawling, current upstream
15633	Inner shelf S of Ría de Vigo	Mudbelt 3 nm N + 250 W of ship wreck	Sediment transport, effect of bottom trawling, current upstream
15634-43			Rumohr core transect along EM-Profile
15644	Inner shelf S of Ría de Vigo	Transect slightly S of ship wreck	Sediment transport, effect of bottom trawling, current upstream
15645	Inner shelf S of Ría de Vigo	Transect slightly S of ship wreck	Sediment transport, effect of bottom trawling, current upstream
15646	Inner shelf S of Ría de Vigo	Transect slightly S of ship wreck	Sediment transport, effect of bottom trawling, current upstream
15647-56			Rumohr core transect along EM-Profile
15657	Gully at 41°58' (southern position)	Mid-course thalweg of gully	Gully activity, shelf export dynamics, first deposition off shelf break
15658	Gully at 41°58' (southern position)	Mid-course thalweg of gully, slightly deeper than 15657	Gully activity, shelf export dynamics, first deposition off shelf break
15659	Gully at 41°58' (southern position)	N flank in gully exit	Gully activity, shelf export dynamics, first deposition off shelf break
15660	Gully at 41°58' (southern position)	Directly inside gully exit, widening and shallowing of thalweg, stratified sediments on "ridge"	Gully activity, shelf export dynamics, first deposition off shelf break
15661	Midshelf off Ría de Pontevedra	Field of wave-shaped ridges, crest of ridge, ruppy basal reflector	Sediment transport and distribution patterns
15662	Midshelf off Ría de Pontevedra	Field of wave-shaped ridges, swale between two ridges	Sediment transport and distribution patterns
15663	Mid-shelf off Ría de Arousa	Ripple-like feature, extent of mudbelt?	Mudbelt evolution + budget calculation, sediment transport pattern
15664-72			Rumohr core transect along EM-Profile
15673	Off the islands in front of Ría de Vigo	Central mudbelt with greatest thickness, two sub-units in PARASOUND	Mudbelt evolution + budget calculation
15674	Inner shelf off Ría de Pontevedra	Local mud depocenters as part of the main mudbelt, between rocky spots	Mudbelt evolution, budget calculation, transport dynamics
15675	Inner shelf off Ría de Pontevedra	Local mud depocenters as part of the main mudbelt, between rocky spots	Mudbelt evolution, budget calculation, transport dynamics
15676	Inner shelf off Ría de Pontevedra	Local mud depocenters as part of the main mudbelt, between rocky spots	Mudbelt evolution, budget calculation, transport dynamics

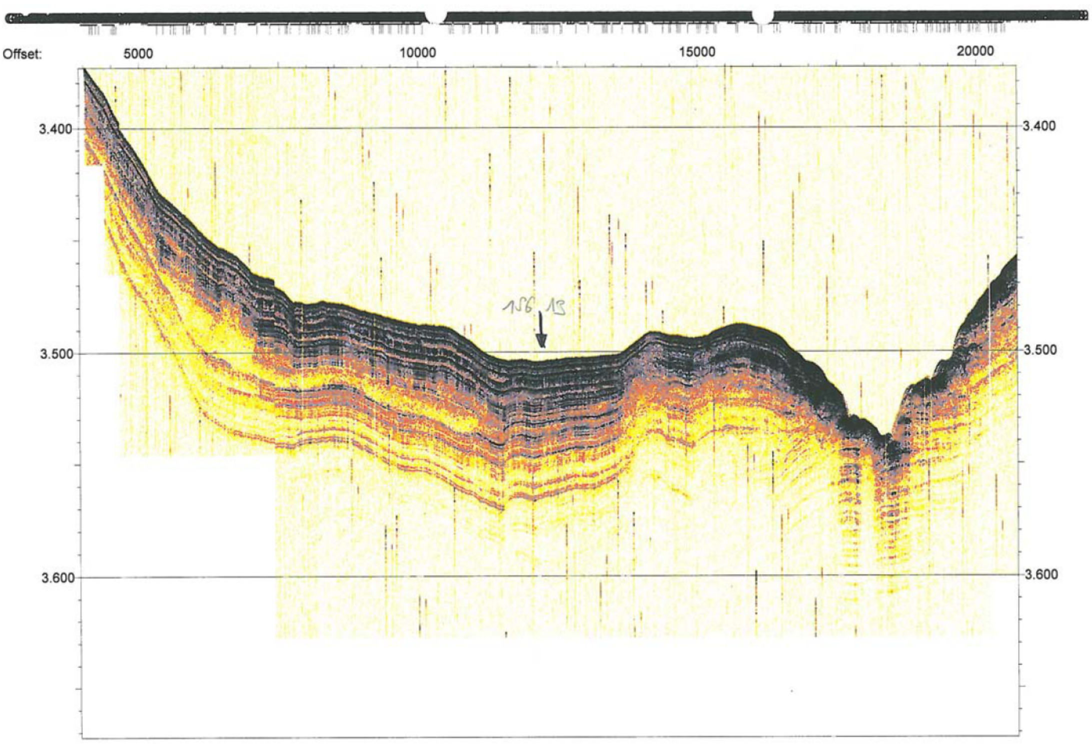
15677	Directly off Ría de Pontevedra	Local mud depocenters as part of the main mudbelt, between rocky spots	Mudbelt evolution, budget calculation, transport dynamics
15678	Directly off Ría de Pontevedra	Isolated sediment patch, local mud depocenters as part of the main mudbelt, between rocky spots	Mudbelt evolution, budget calculation, transport dynamics, insight into mudbelt margin dynamics
15679	Mid-shelf off Ría de Pontevedra, across the rocky outlet	Thick isolated depocenter off mudbelt	Mudbelt evolution, budget calculation, transport dynamics
15680	S off the Ría de Arousa	Local depocenter behind submarine rock outcrop	Sediment transport pattern
15681	Mid-shelf off Ría de Pontevedra	Older reflector close to surface	Stratigraphic framework
15682	Mid-shelf off Ría de Pontevedra	PARASOUND shows anormal deep “spike”	Gas vent?
15683	Inner shelf between Rías de Arousa and Pontevedra	Thick mud depocenter	Mudbelt evolution, budget calculation, transport dynamics
15684	Inner shelf off Ría de Arousa	Thick sediment wedge laying around a steep rocky elevation	Mudbelt evolution, budget calculation, transport dynamics
15685	Rocky area off Ría de Arousa (heavy fishing activity?	Older reflectors close to surface	Sediment transport and distribution patterns
15686	Rocky area off Ría de Arousa (heavy fishing activity?	Distal pinch-out of this deposit overlying older units	Sediment transport and distribution patterns
15687	Rocky area off Ría de Arousa (heavy fishing activity?	Current-dominated thick deposits at rock outcrop (“contouritic”)	Sediment transport and distribution patterns
15688	Head of main canyon system N of mount	Terrace just below shelf break, nicely stratified sediments and slumped material	Shelf sediment export dynamics, most proximal depocenter off the shelf break
15689	Head of main canyon system N of mount	Thalweg with slightly stratified base	Shelf sediment export dynamics
15690	Head of main canyon system N of mount	Thalweg with slightly stratified base	Shelf sediment export dynamics
15691	Head of main canyon system N of mount	Thalweg with slightly stratified base	Shelf sediment export dynamics
15692	Head of main canyon system N of mount	Thalweg with slightly stratified base	Shelf sediment export dynamics
15693	Head of main canyon system N of mount	Thalweg with slightly stratified base	Shelf sediment export dynamics
15694-15709			Rumohr core transect along EM-Profile

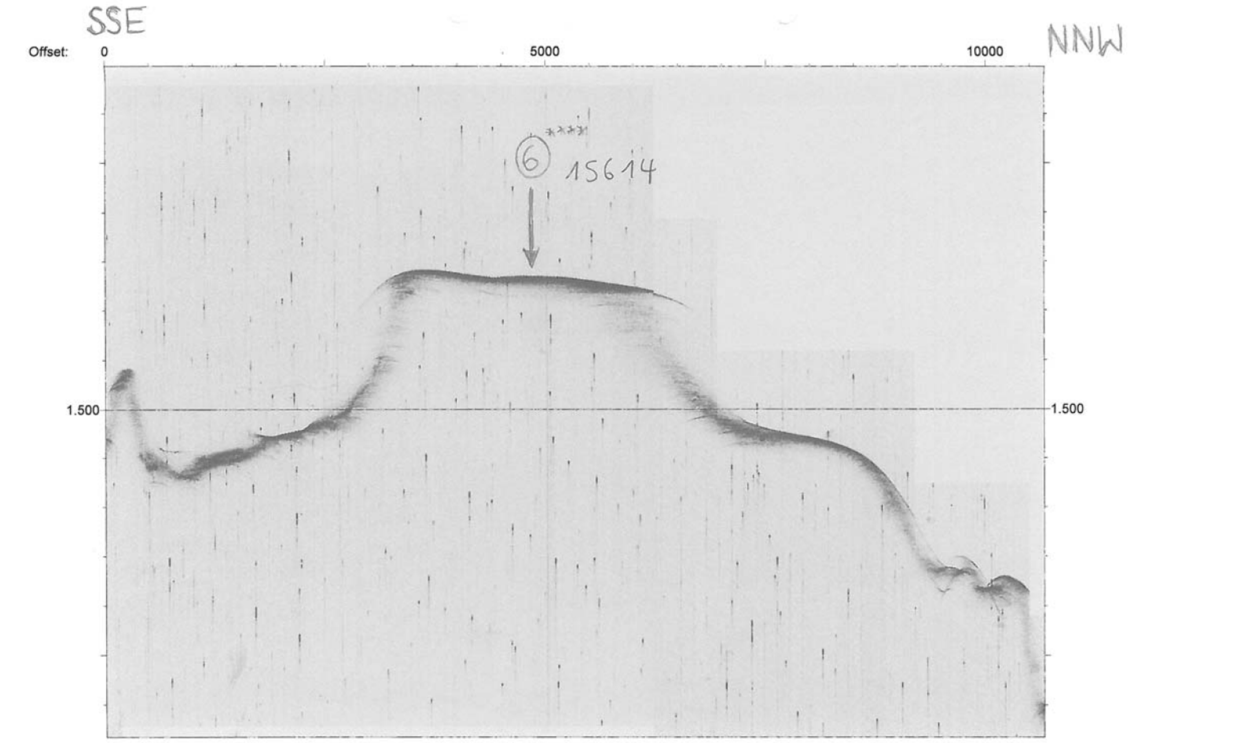
7.2.2 Core Positions in PARASOUND Profiles



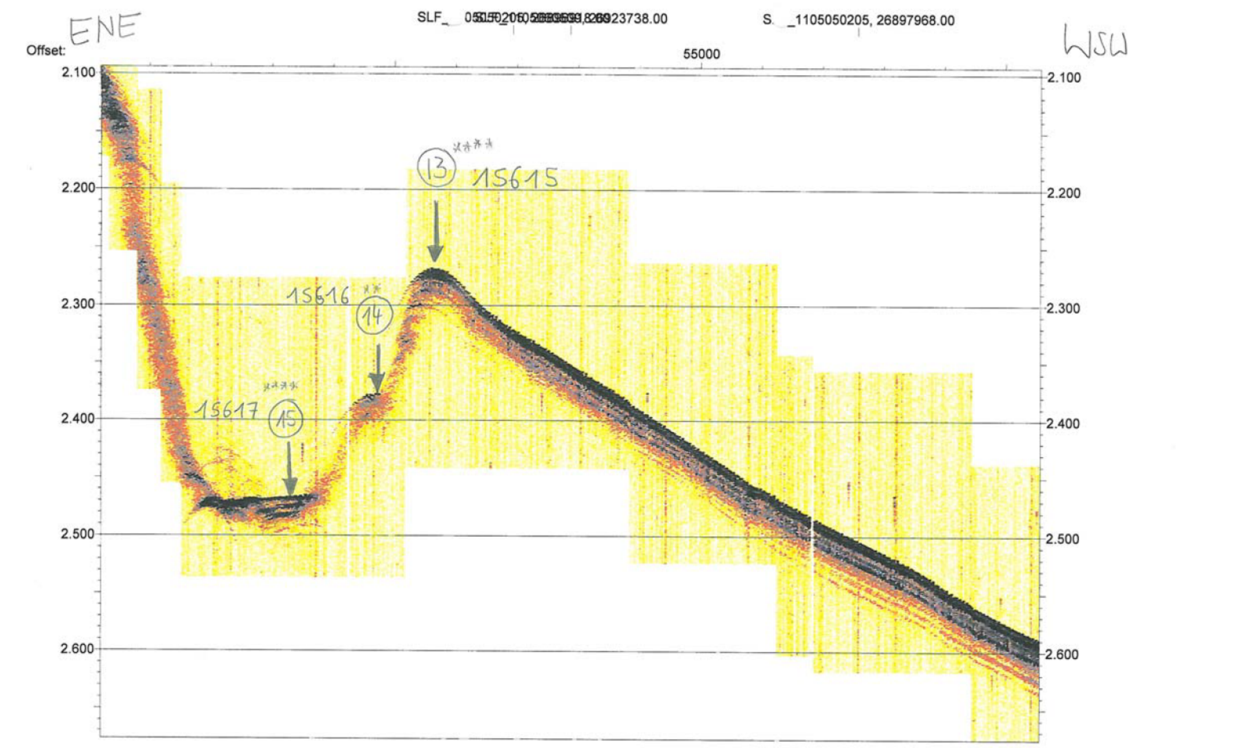



May 5
15609
Water Depth [m]
1950
2000
2050
2100
2150
2200
2250
2300
2350
2400
15:55 16:00 16:05 16:10 16:15 16:20 16:25 16:30 16:35 16:40 16:45 16:50 16:55 17:00 17:05 17:10 17:15 17:20 17:25 17:30 17:35 17:40 17:45 17:50 17:55 18:00 18:05 18:10 18:15 18:20 18:25 18:30 18:35 18:40 18:45 18:50 18:55 19:00 19:05 19:10 19:15 19:20 19:25 19:30 19:35 19:40
35.00
40.00
45.00
50.00
55.00
60.00
65.00

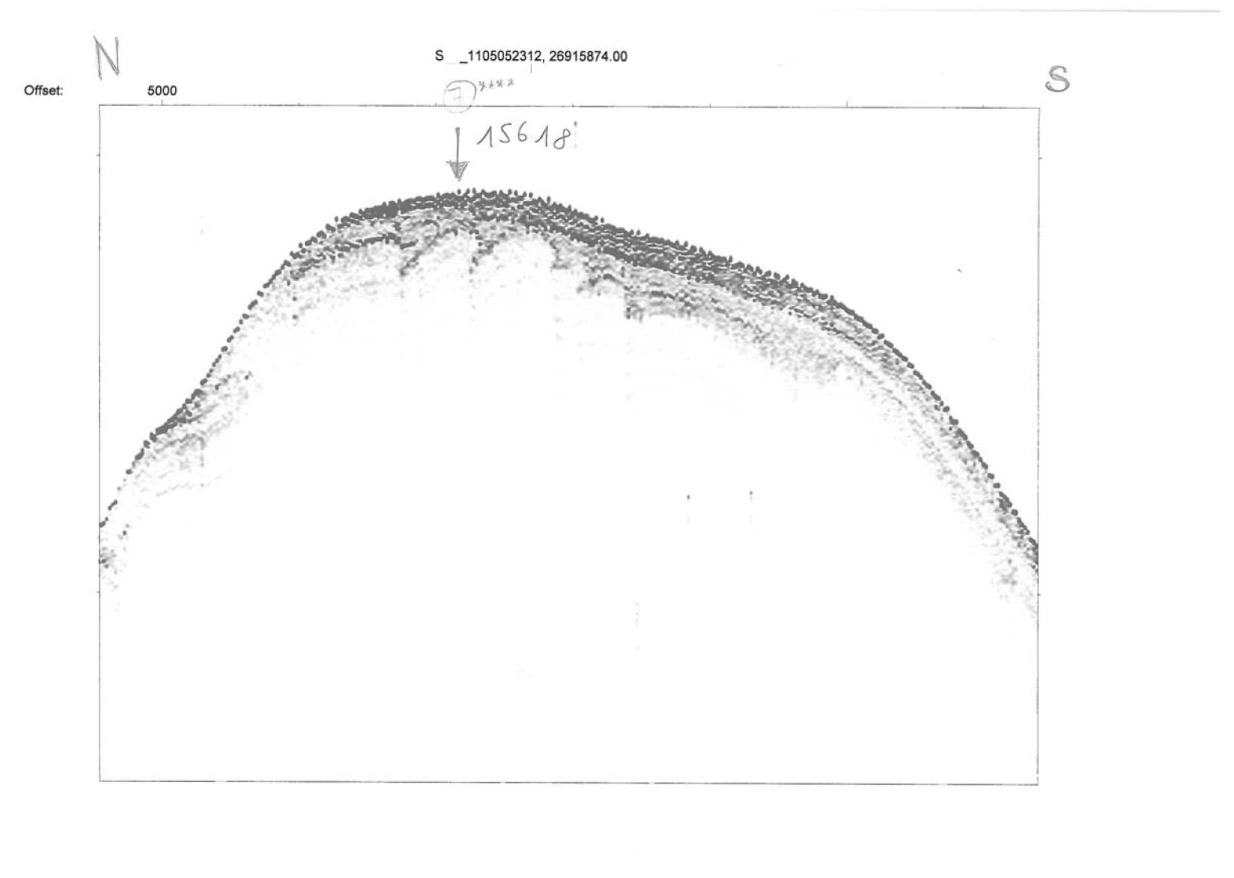

Offset:
5000
10000
15000
20000
3.400
3.500
3.600
15613

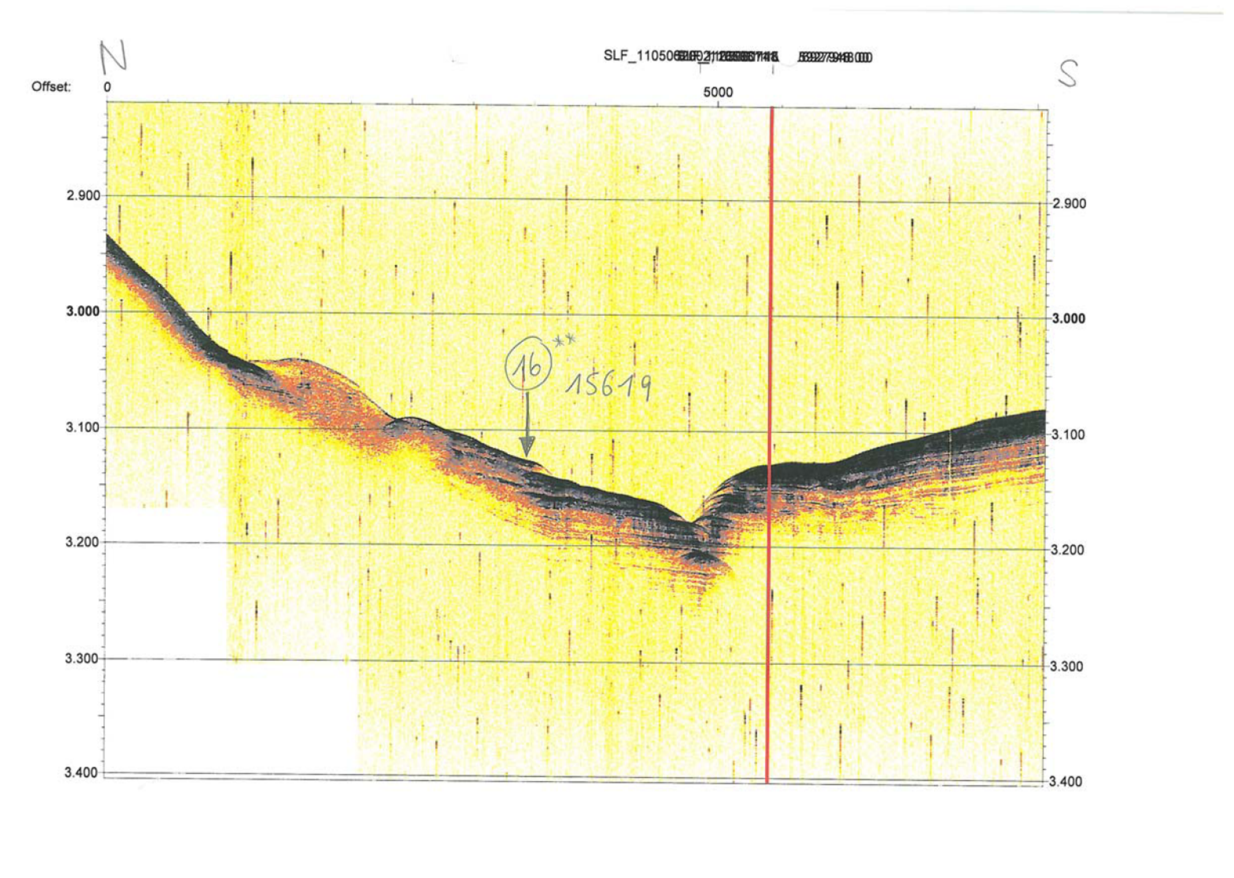


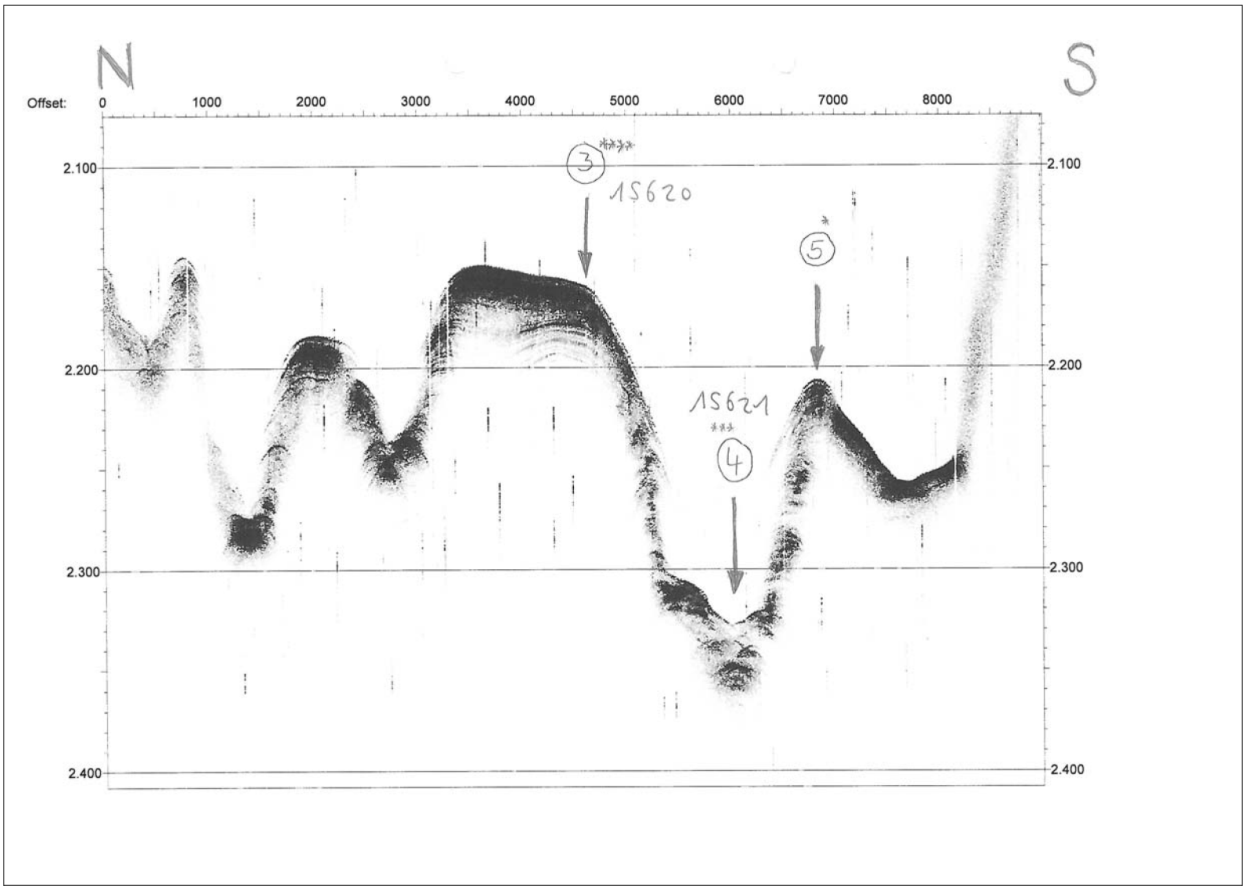
SSE
Offset:
0
5000
10000
NNW
6
15614
1.500
1.500

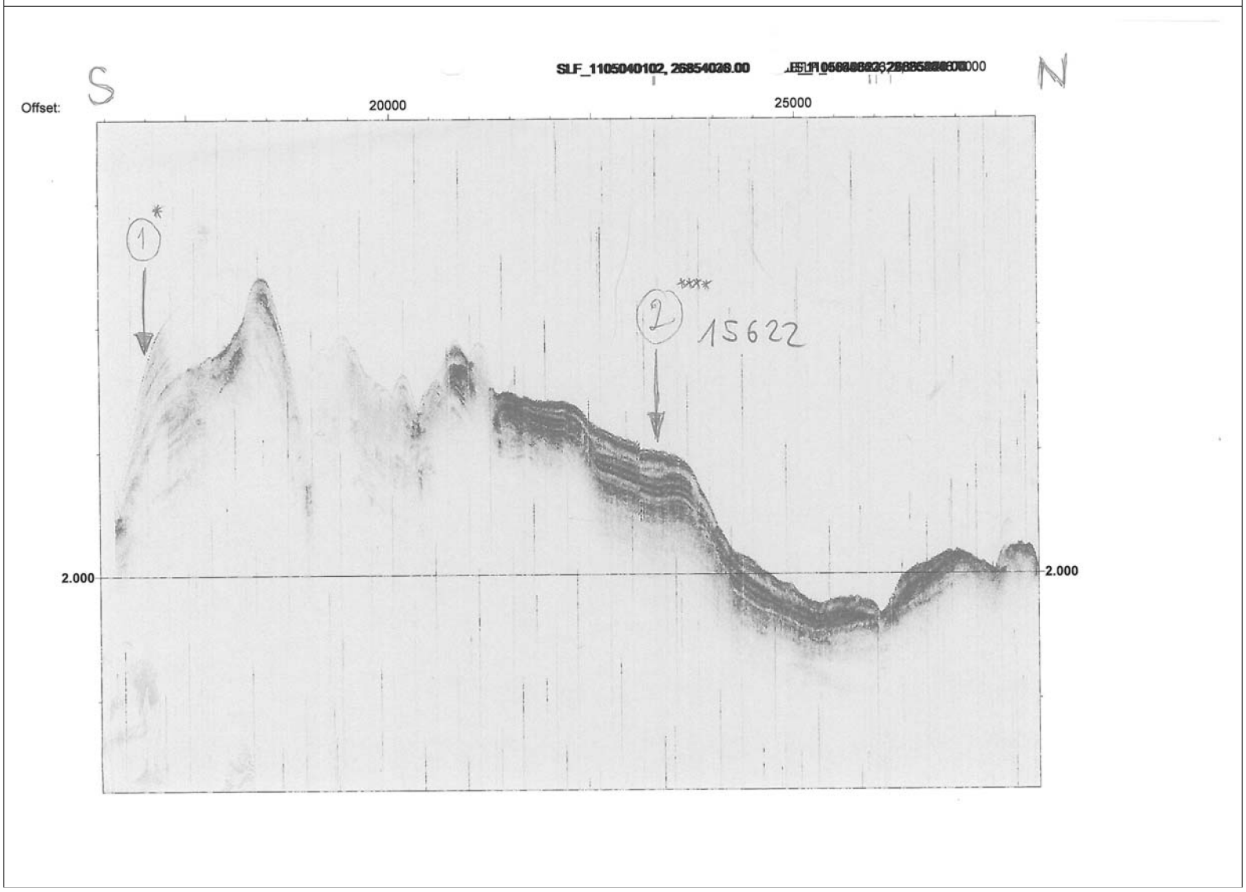


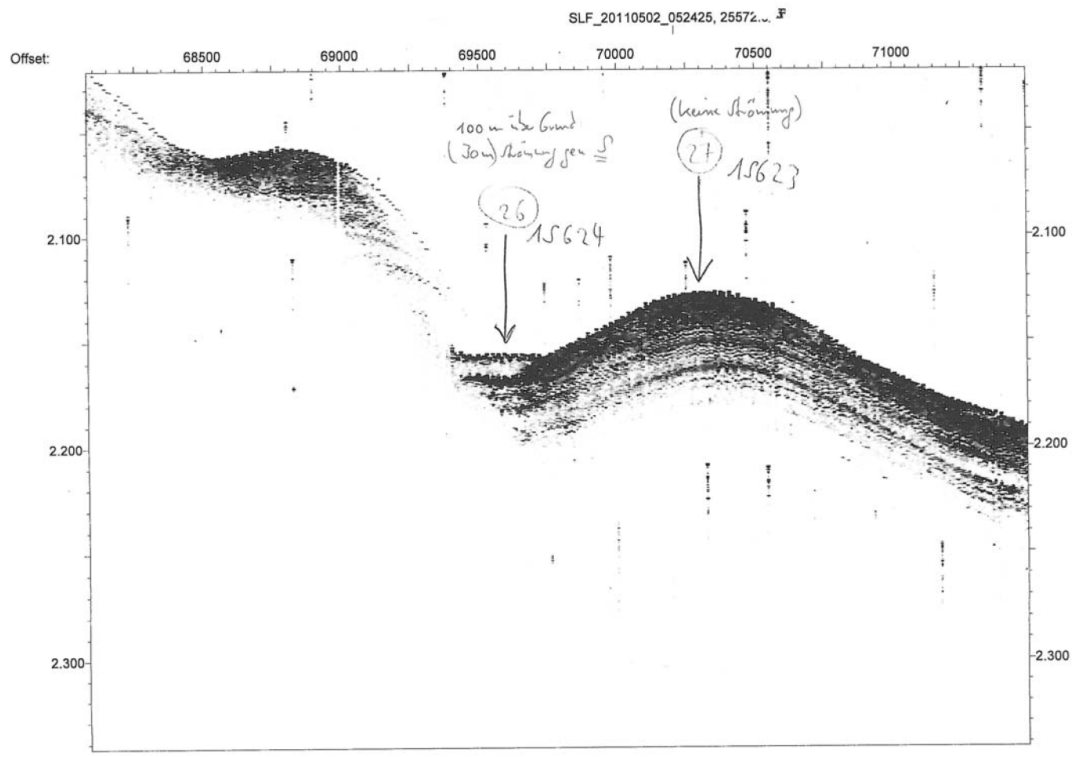
ENE
S. _1105050205, 26897968.00
Offset:
55000
WSW
2.100
2.200
2.300
2.400
2.500
2.600
13
15615
15616
14
15617
15

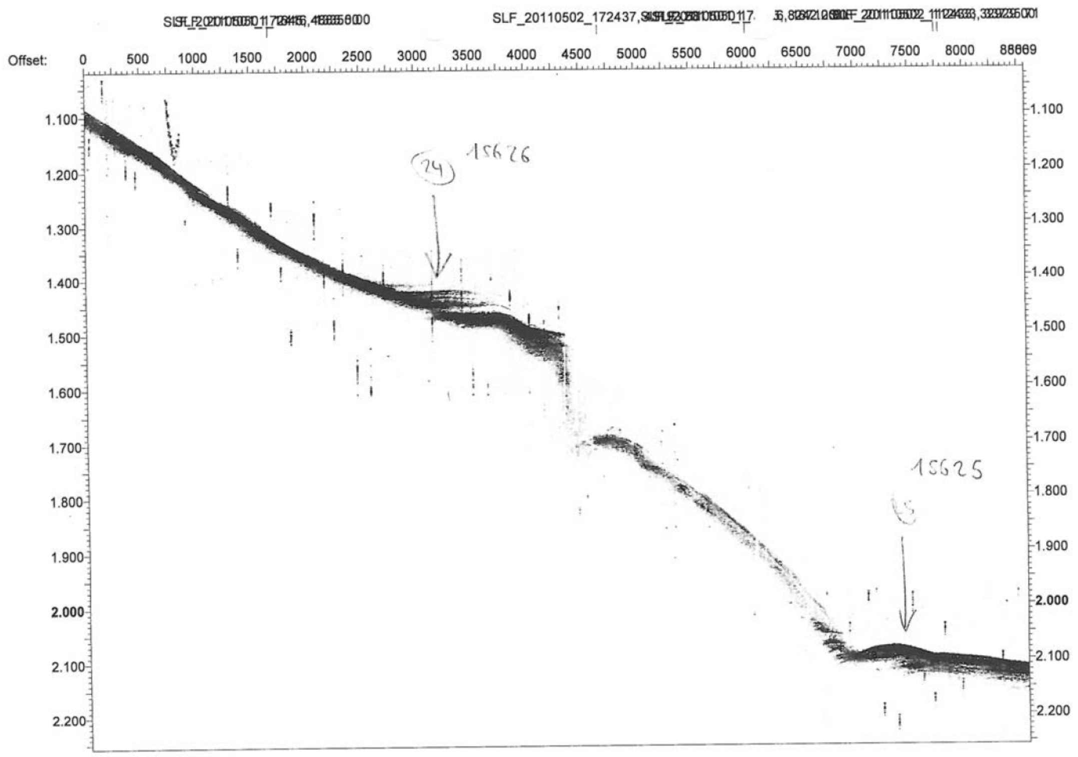

N
S _1105052312, 26915874.00
Offset:
5000
S
7
15618

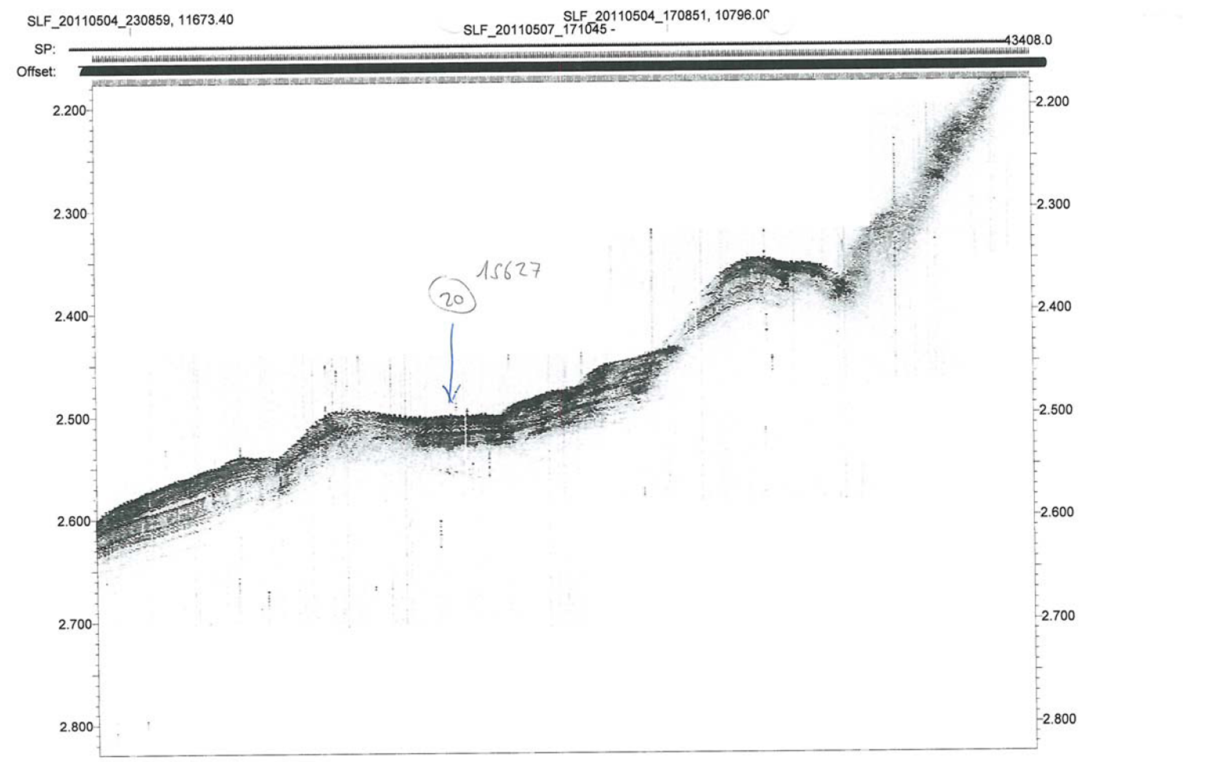

N
Offset:
0
5000
S
2.900
3.000
3.100
3.200
3.300
3.400
16
15619

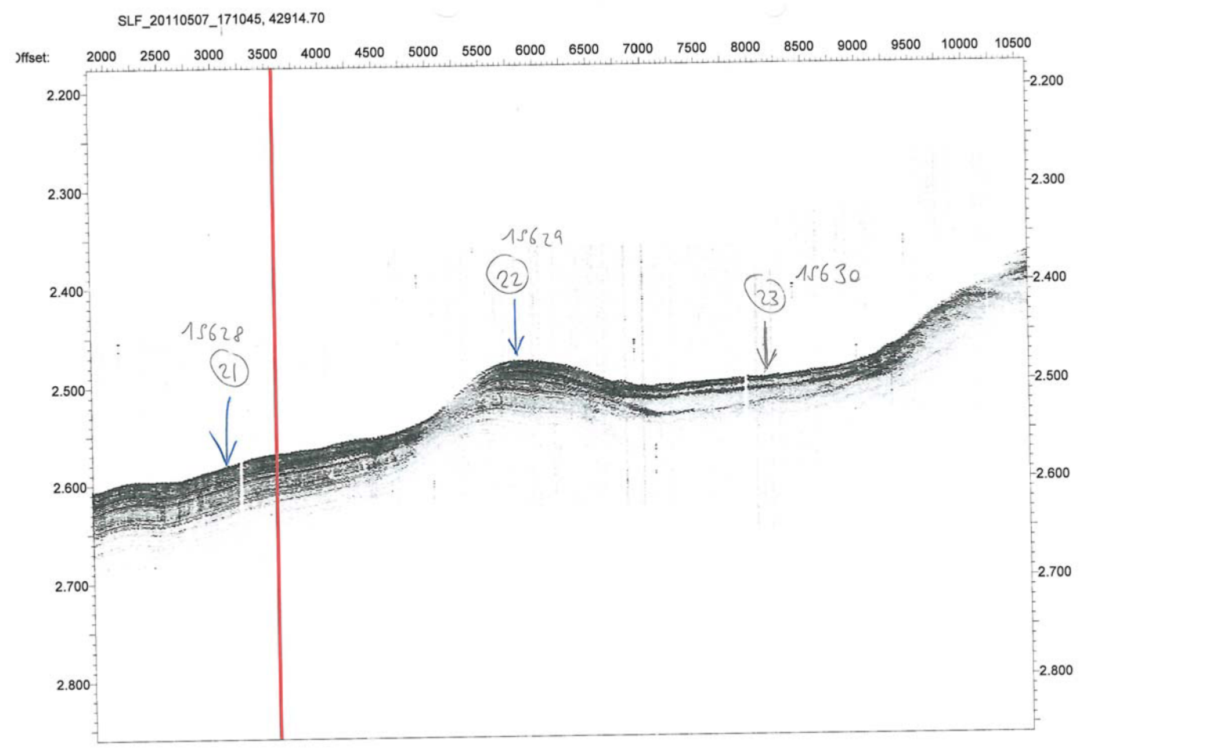

N
S
Offset:
0
1000
2000
3000
4000
5000
6000
7000
8000
2.100
2.200
2.300
2.400
3
15620
15621
4
5

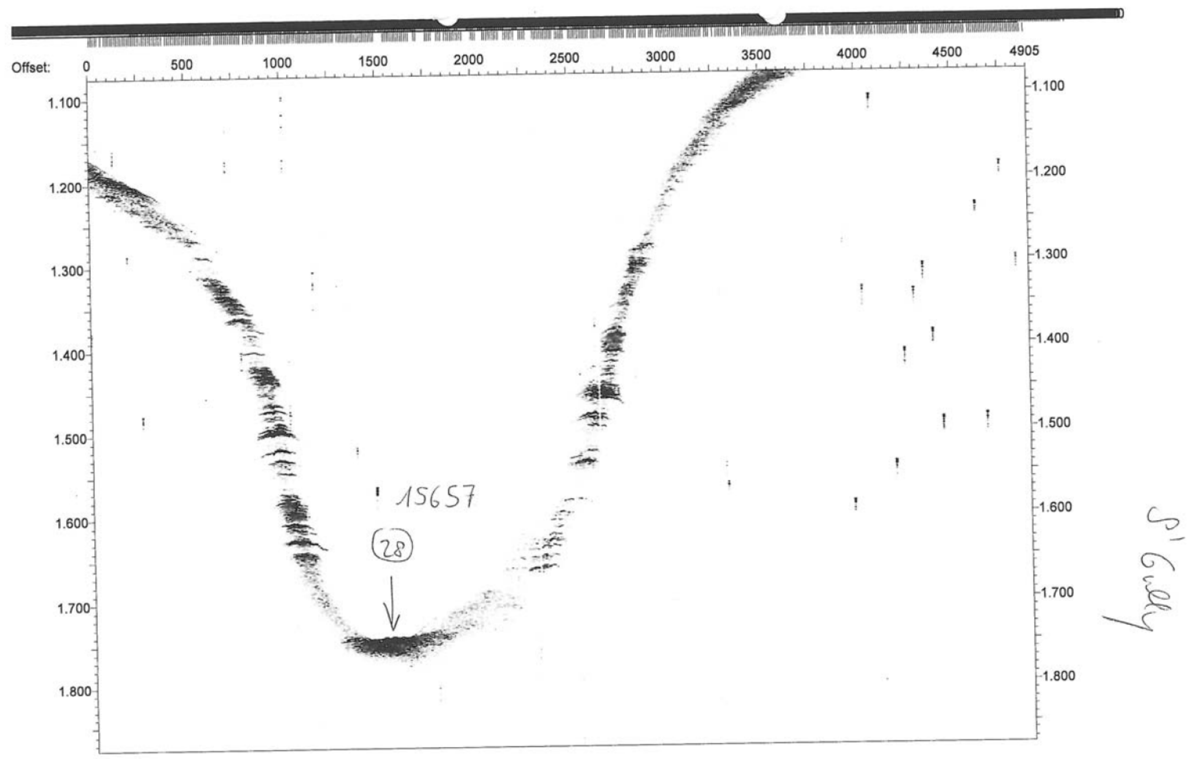

S
N
SLF_1105040102, 26854030.00
Offset:
20000
25000
2.000
1
2
15622

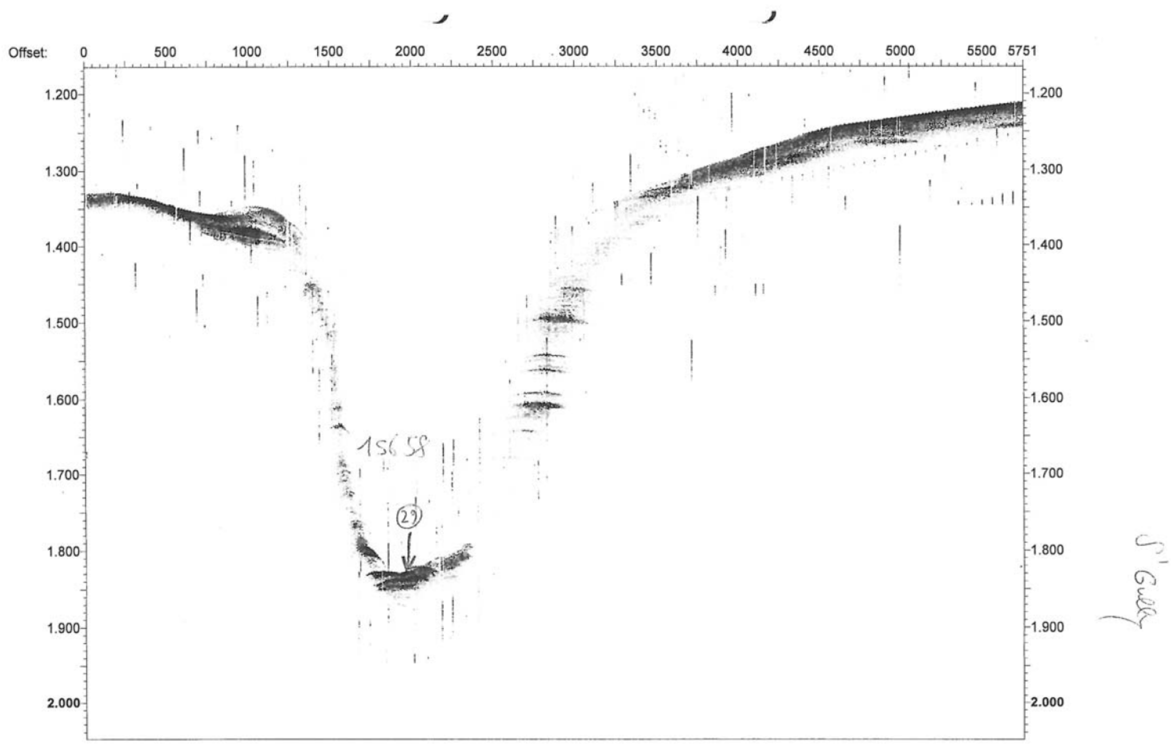

SLF_20110502_052425, 25572..
Offset:
68500
69000
69500
70000
70500
71000
2.100
2.200
2.300
100 m über Grund
(30 m) Strömung gen S
26
15624
(keine Strömung)
27
15623

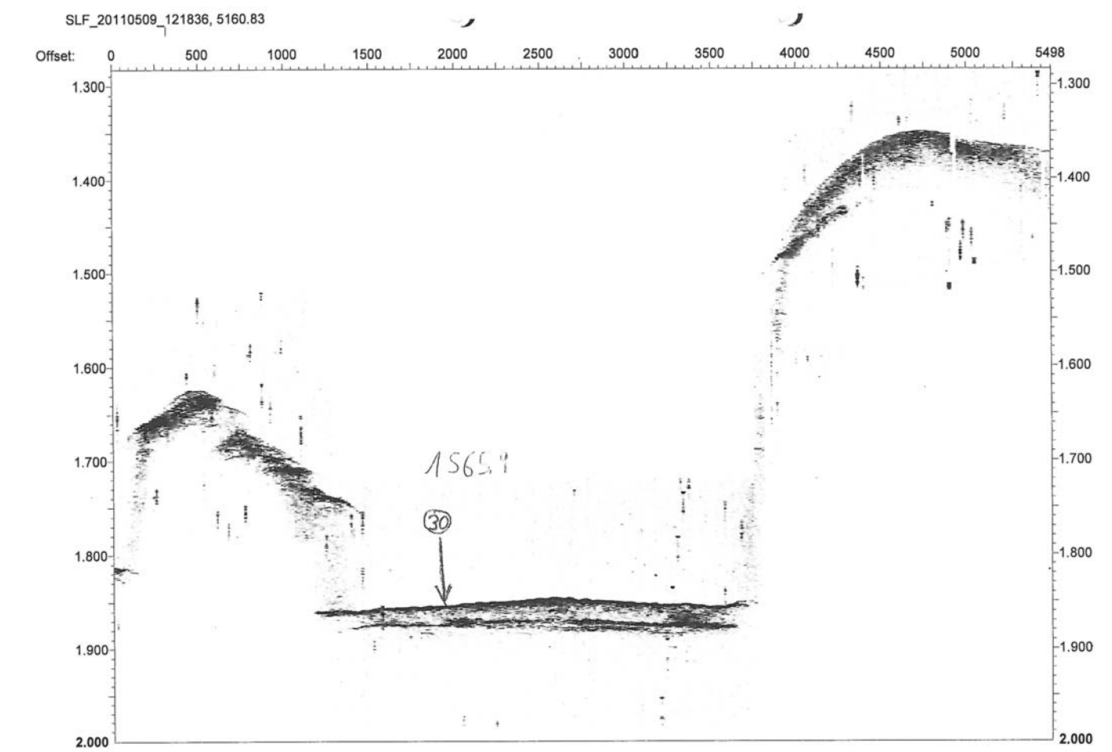

SLF_20110502_172437
Offset:
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
6500
7000
7500
8000
1.100
1.200
1.300
1.400
1.500
1.600
1.700
1.800
1.900
2.000
2.100
2.200
24
15626
15625

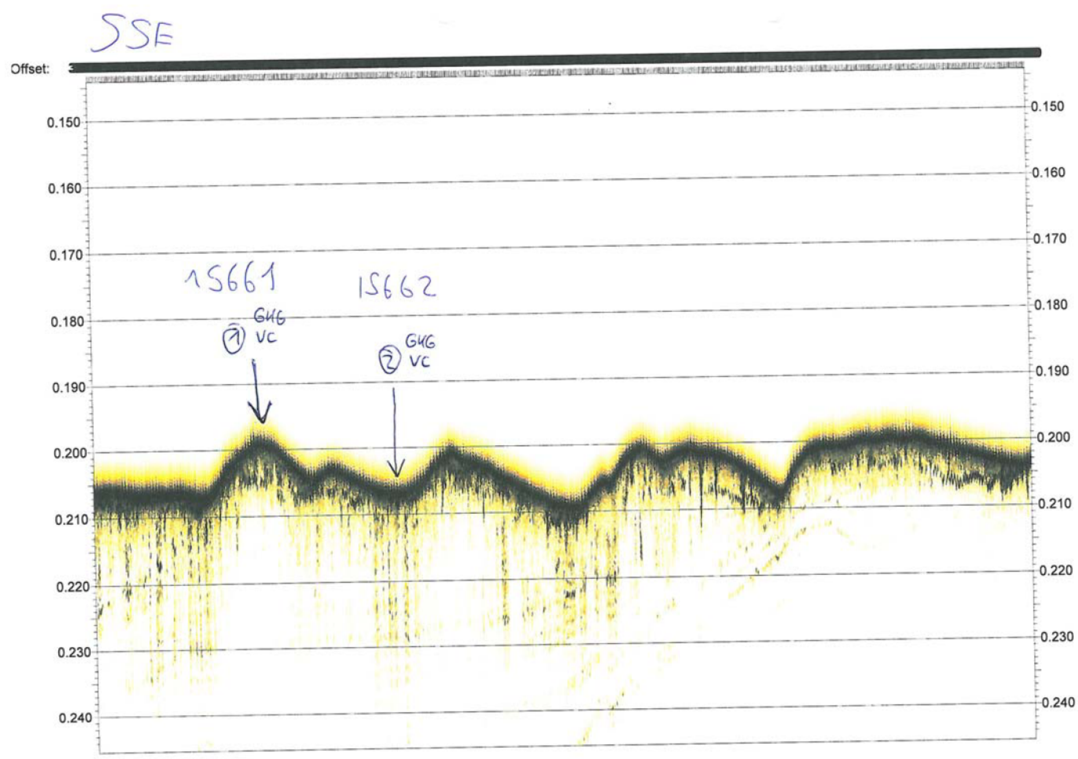

SLF_20110504_230859, 11673.40
SLF_20110504_170851, 10796.0
SLF_20110507_171045 -
SP:
43408.0
Offset:
2.200
2.300
2.400
2.500
2.600
2.700
2.800
15627
20

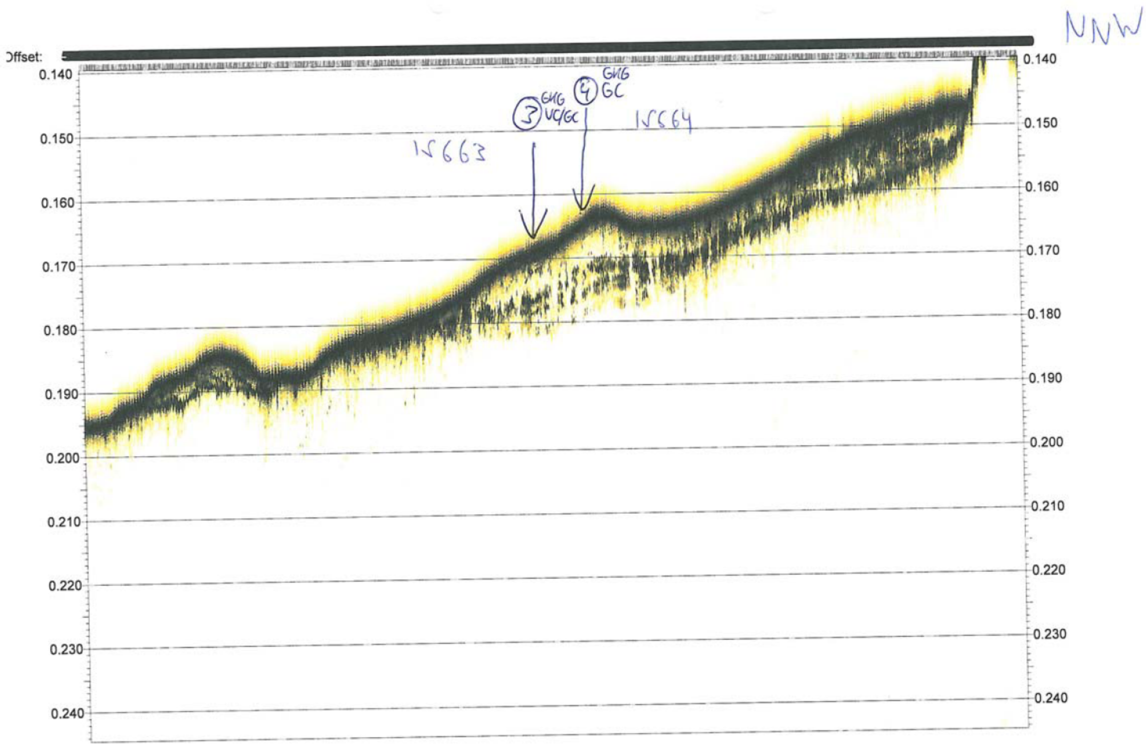

SLF_20110507_171045, 42914.70
Offset:
2000
2500
3000
3500
4000
4500
5000
5500
6000
6500
7000
7500
8000
8500
9000
9500
10000
10500
2.200
2.300
2.400
2.500
2.600
2.700
2.800
15628
21
15629
22
15630
23

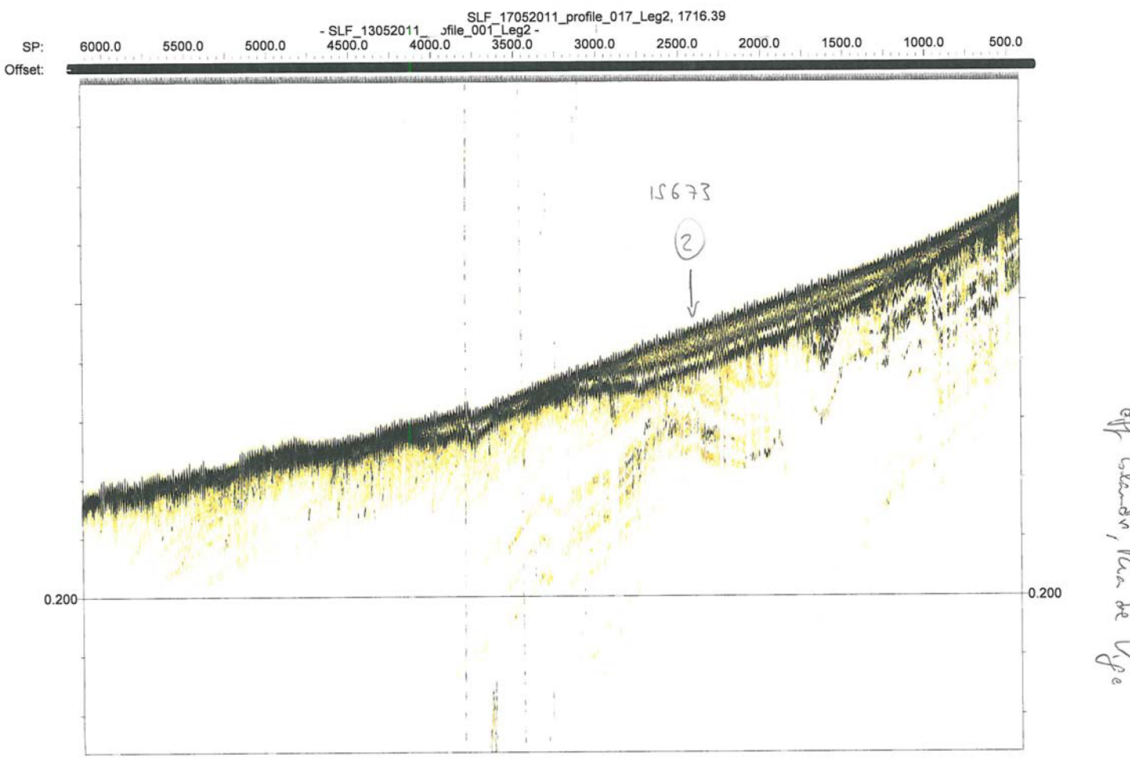

Offset: 0 500 1000 1500 2000 2500 3000 3500 4000 4500 4905
1.100 1.200 1.300 1.400 1.500 1.600 1.700 1.800
15657
28
S' Gully

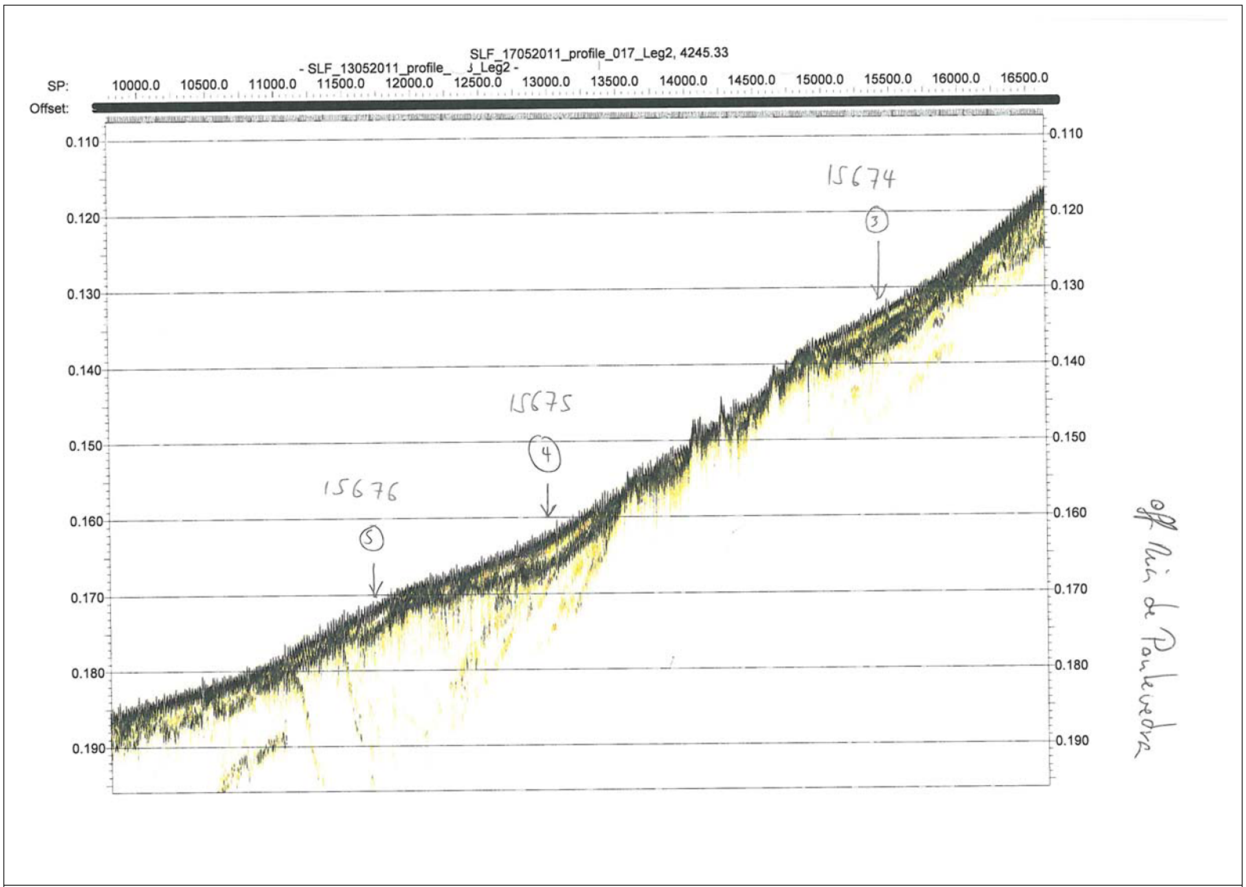

Offset: 0 500 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500 5751
1.200 1.300 1.400 1.500 1.600 1.700 1.800 1.900 2.000
15658
29
S' Gully

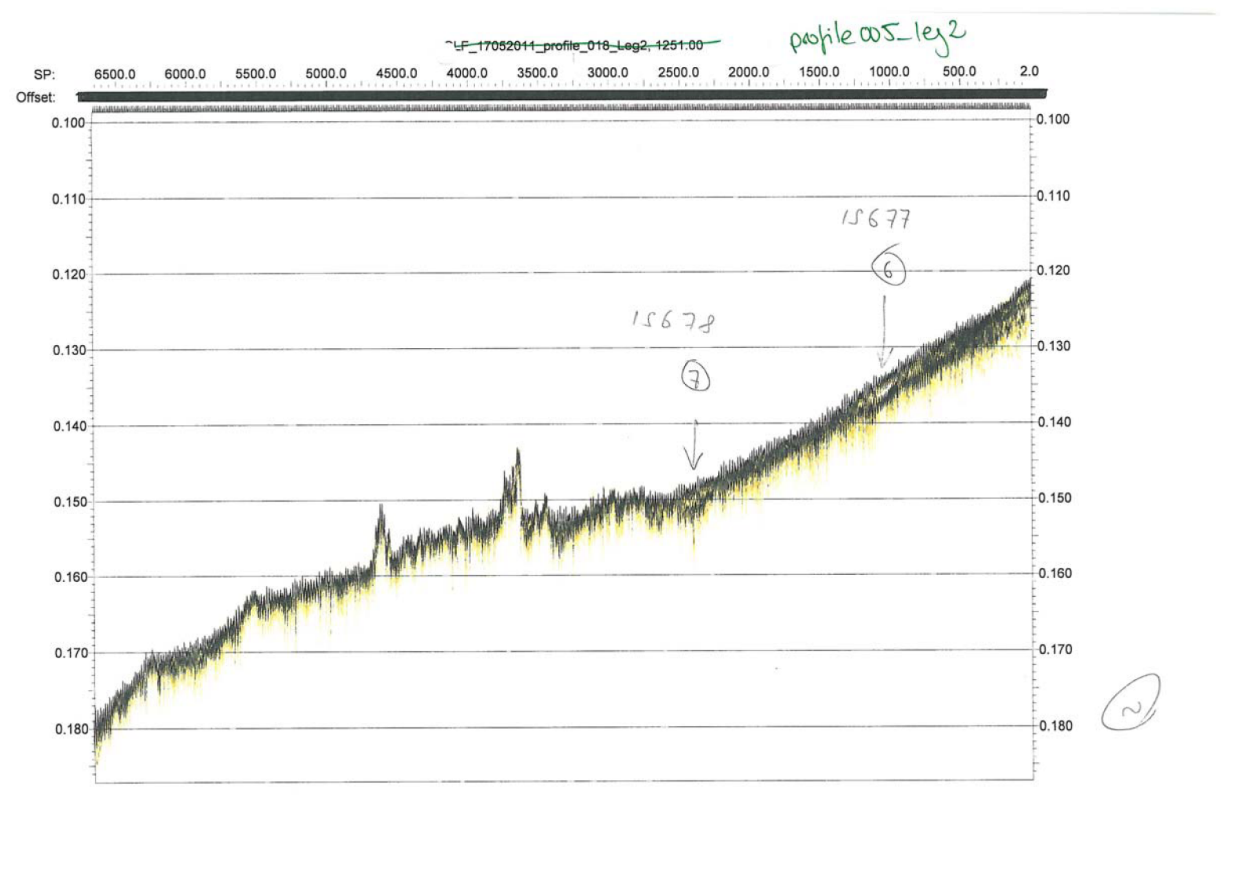

SLF_20110509_121836, 5160.83
Offset:
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5498
1.300
1.400
1.500
1.600
1.700
1.800
1.900
2.000
15659
30
S' Gully

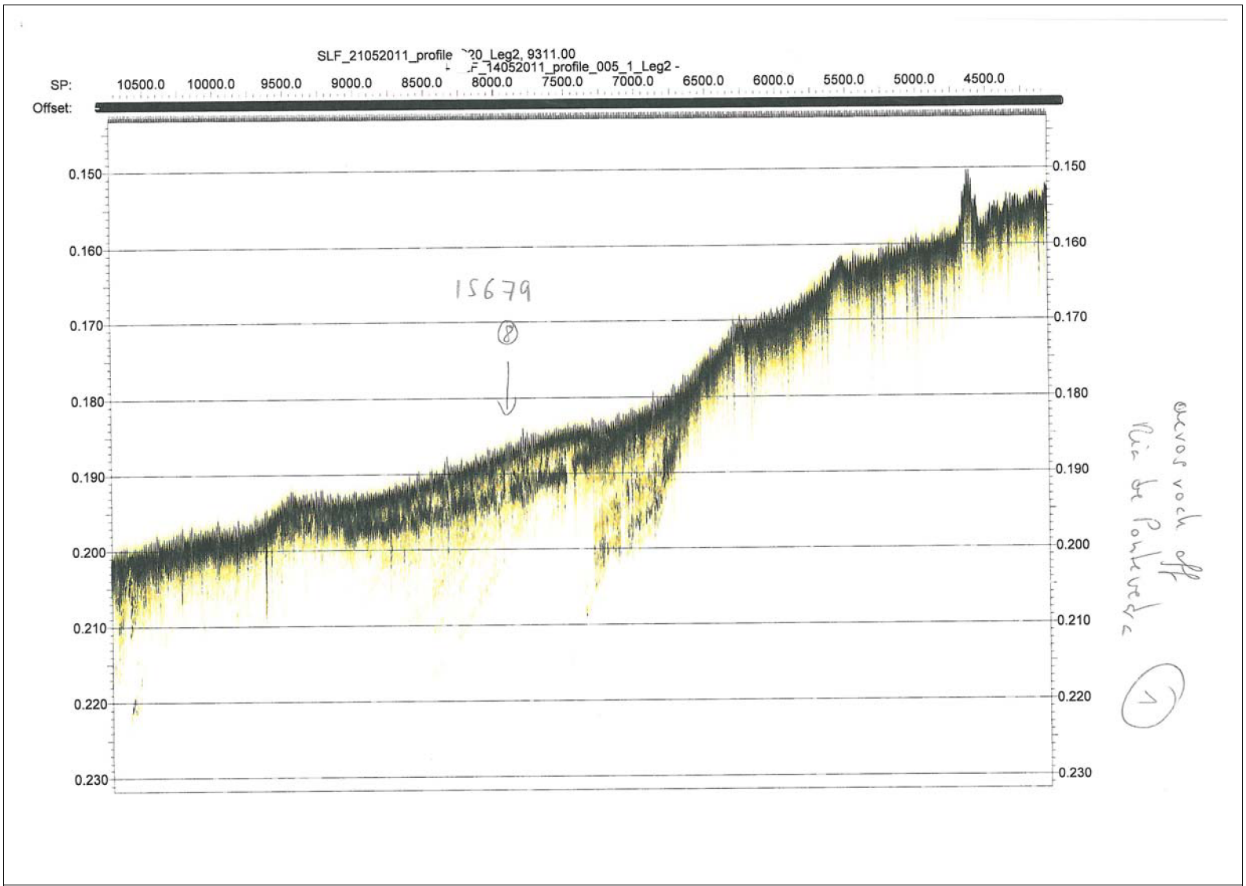

SSE
Offset:
0.150
0.160
0.170
0.180
0.190
0.200
0.210
0.220
0.230
0.240
15661
15662
1 GHG VC
2 GHG VC

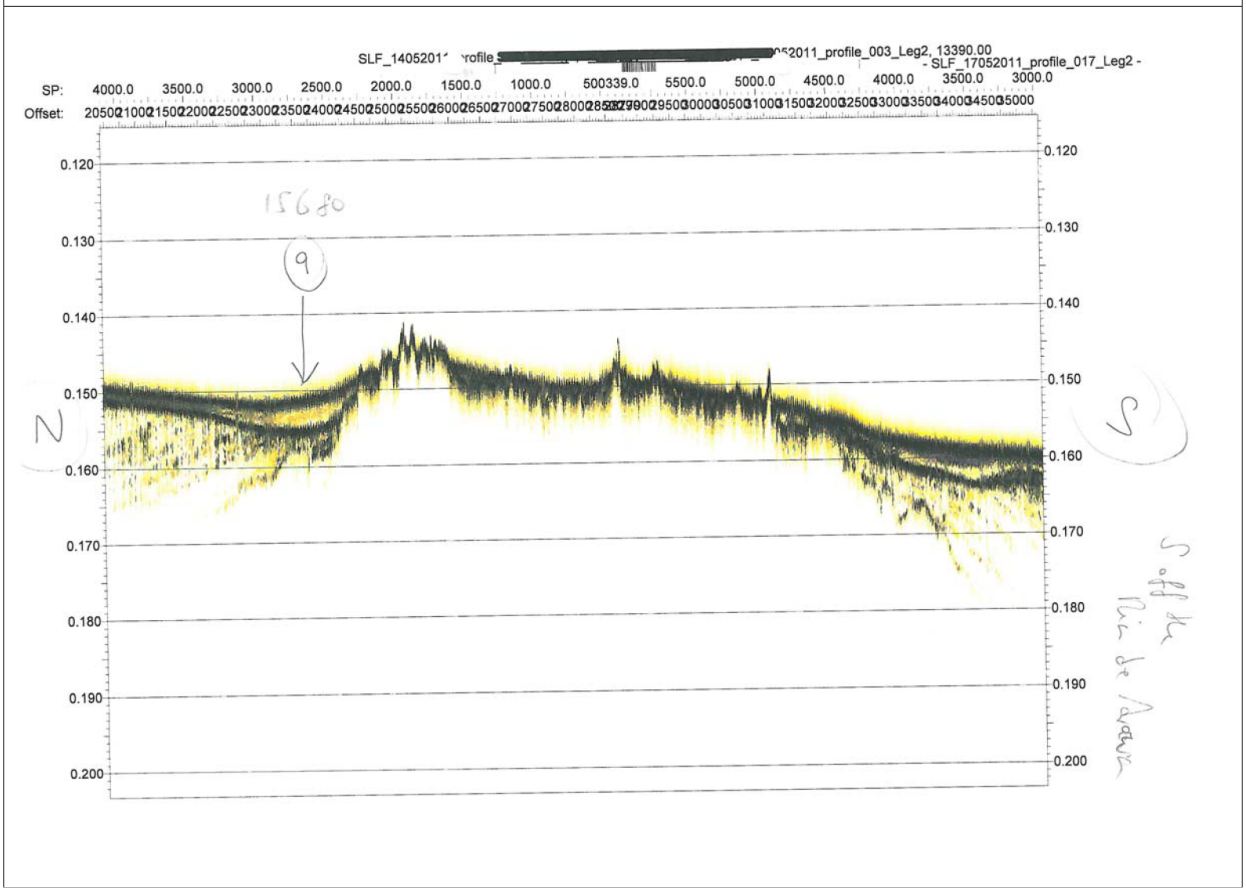

NNW
Offset:
0.140
0.150
0.160
0.170
0.180
0.190
0.200
0.210
0.220
0.230
0.240
1S663
3 GHG VC/GC
4 GHG GC
1S664

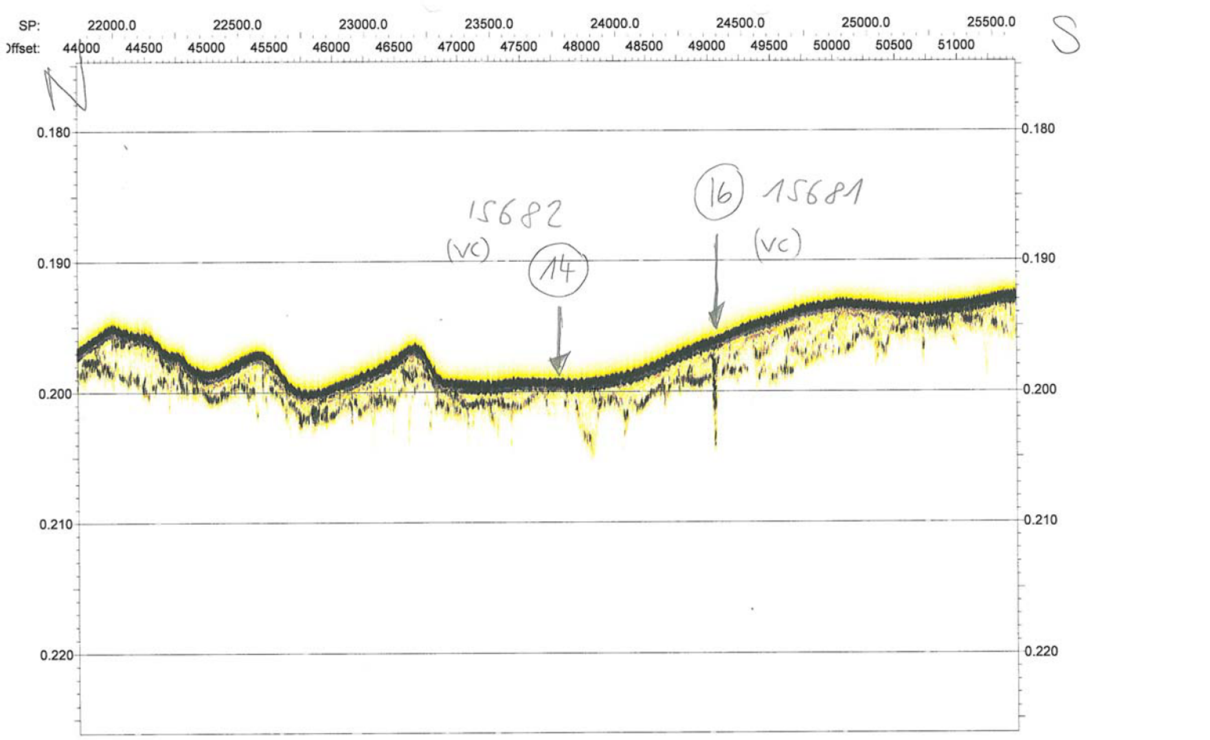

SLF_17052011_profile_017_Leg2, 1716.39
- SLF_13052011_ ofile_001_Leg2 -
SP: 6000.0 5500.0 5000.0 4500.0 4000.0 3500.0 3000.0 2500.0 2000.0 1500.0 1000.0 500.0
Offset:
1S673
2
0.200
off islands, Ria de Vigo

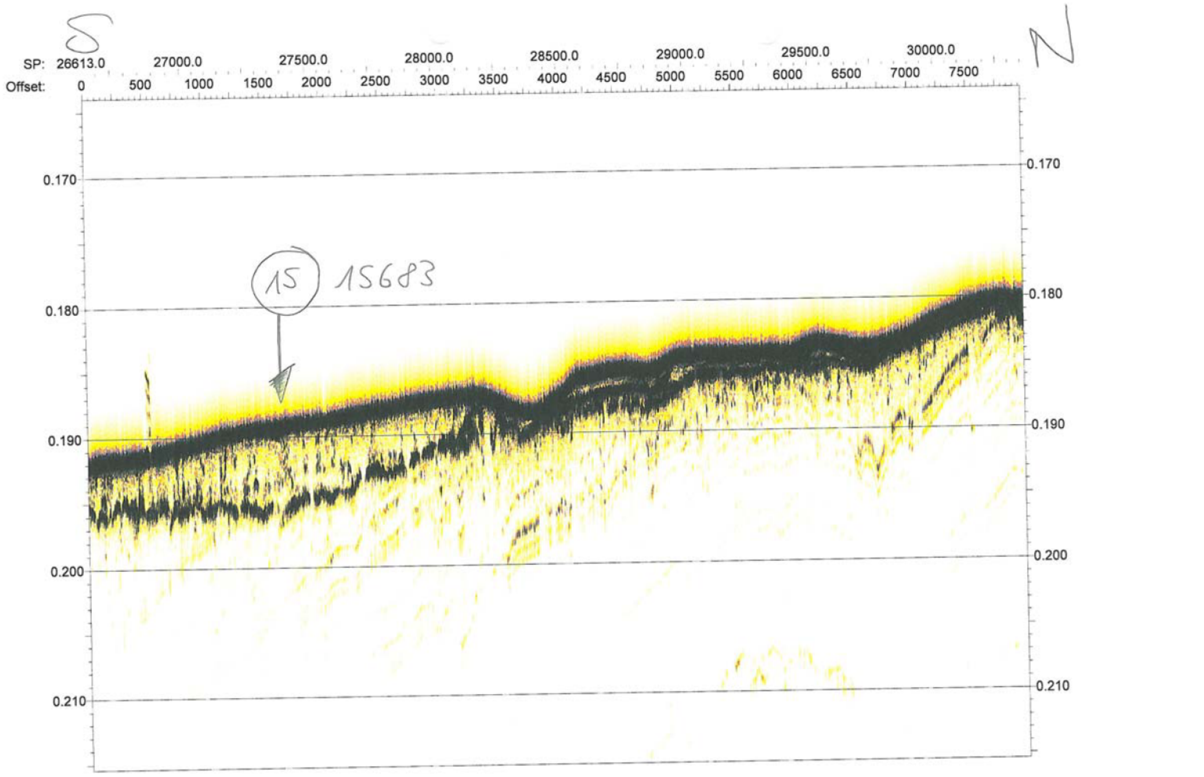

SLF_17052011_profile_017_Leg2, 4245.33
- SLF_13052011_profile_ _Leg2 -
SP:
Offset:
15674
③
15675
④
15676
⑤
off Ria de Pontevedra

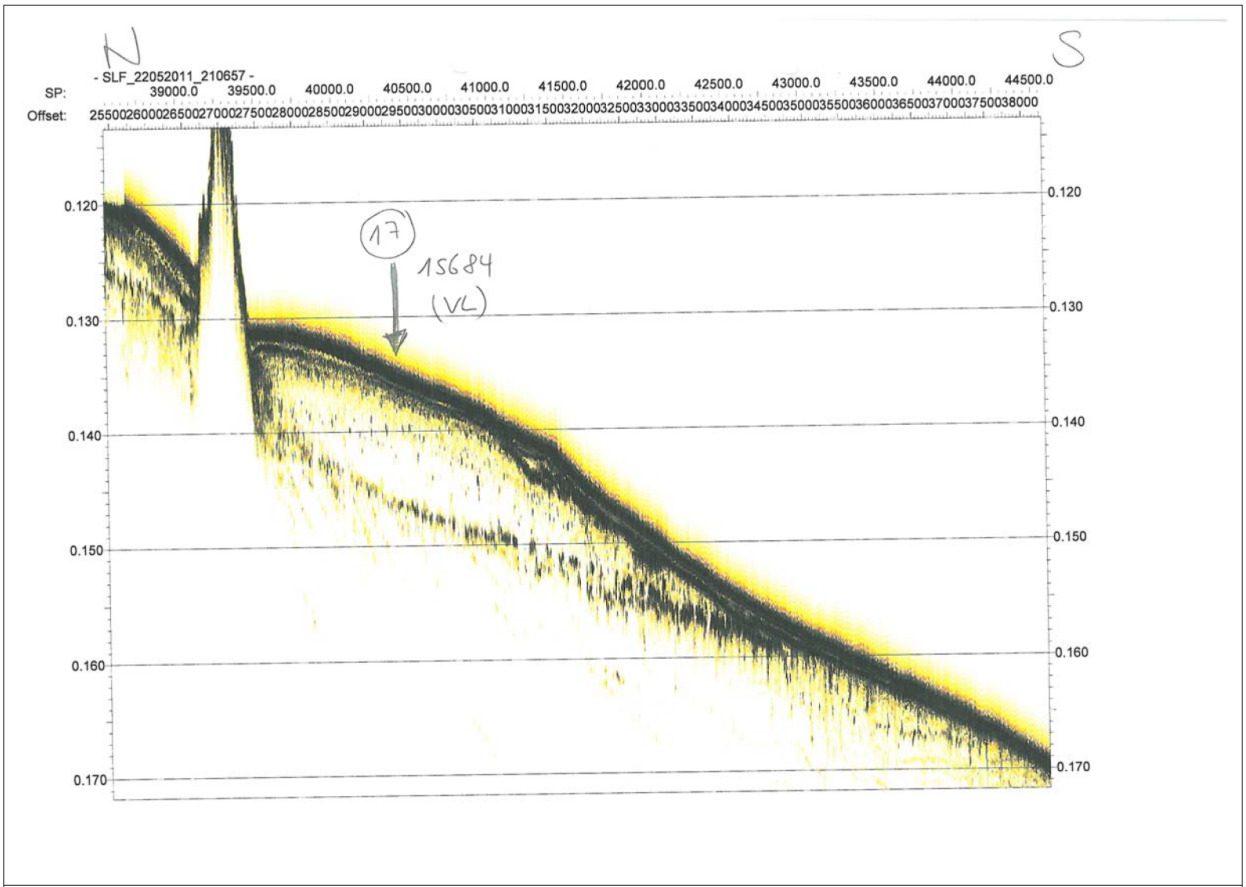

SLF_17052011_profile_018_Leg2, 1251.00
profile 005_leg2
SP:
Offset:
15677
⑥
15678
⑦
②

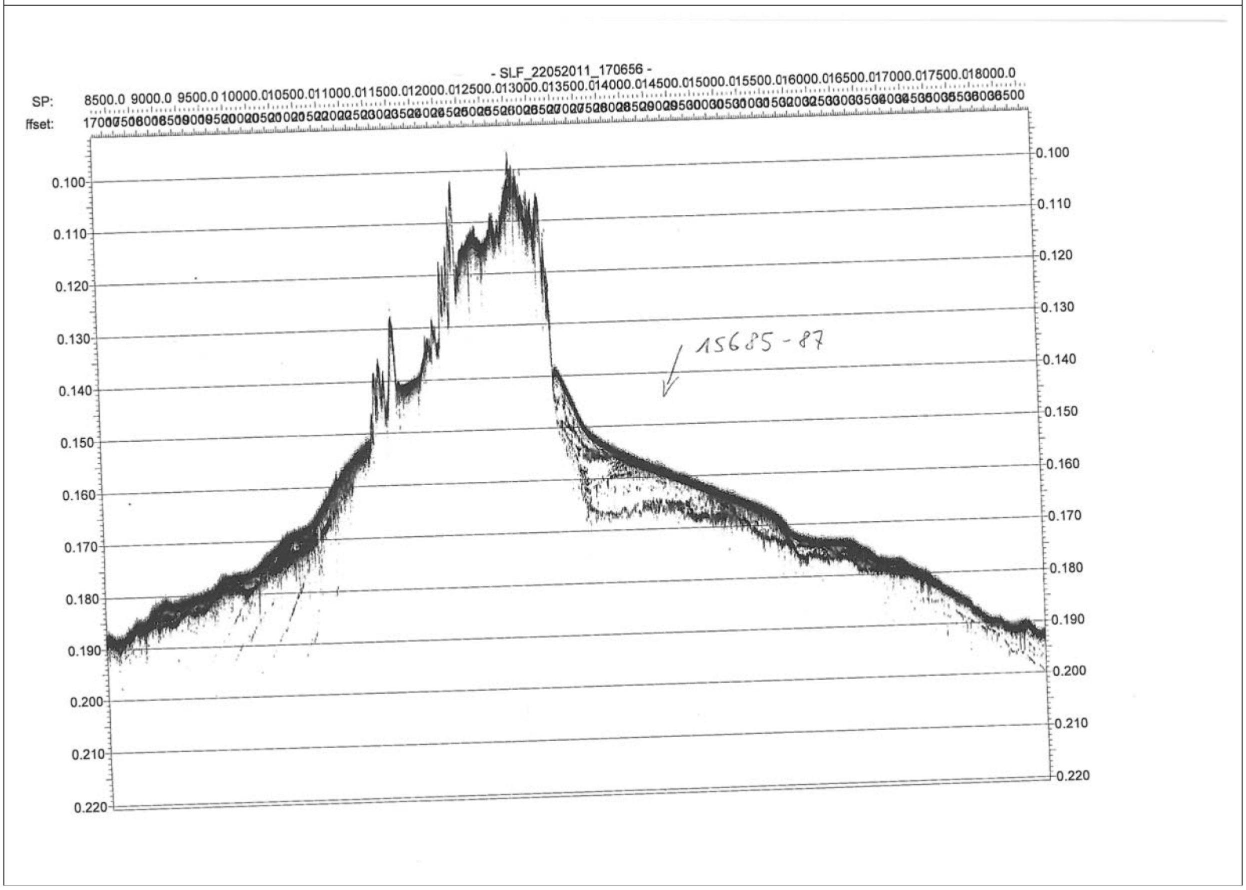

SLF_21052011_profile
SLF_14052011_profile_005_1_Leg2 -
SP:
Offset:
15679
8

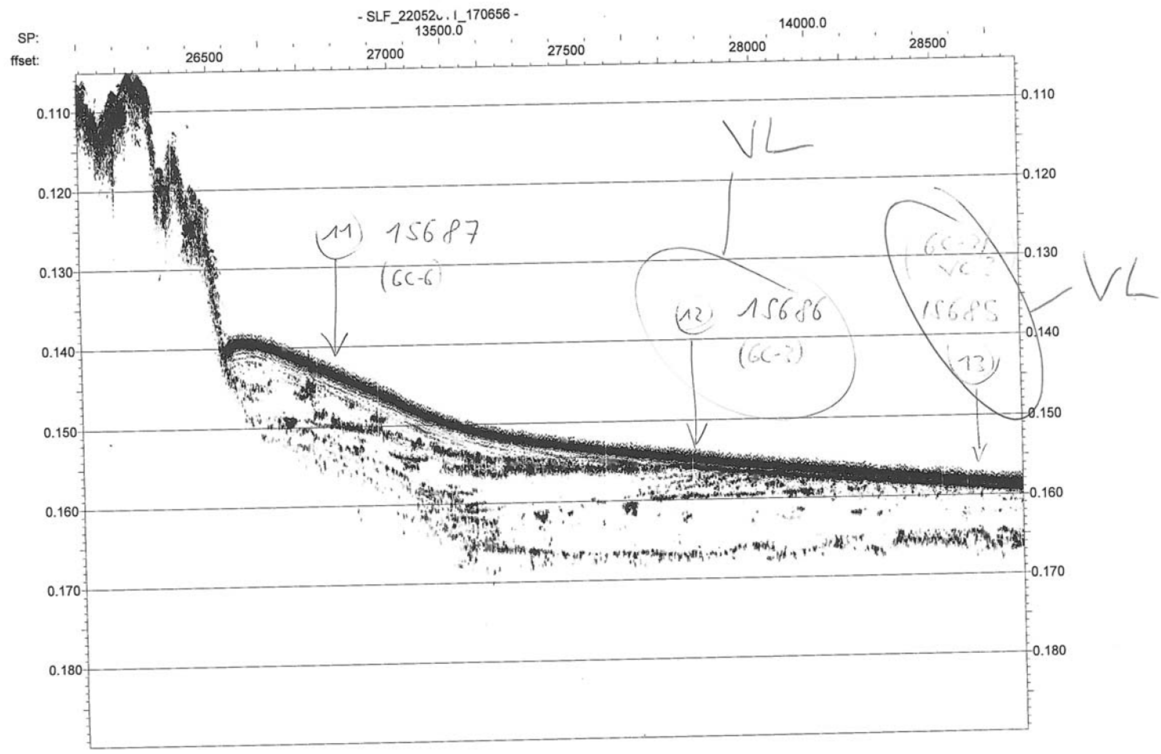

SLF_1405201
rofile
[redacted]
52011_profile_003_Leg2, 13390.00
SLF_17052011_profile_017_Leg2 -
SP:
Offset:
15680
9
N
S

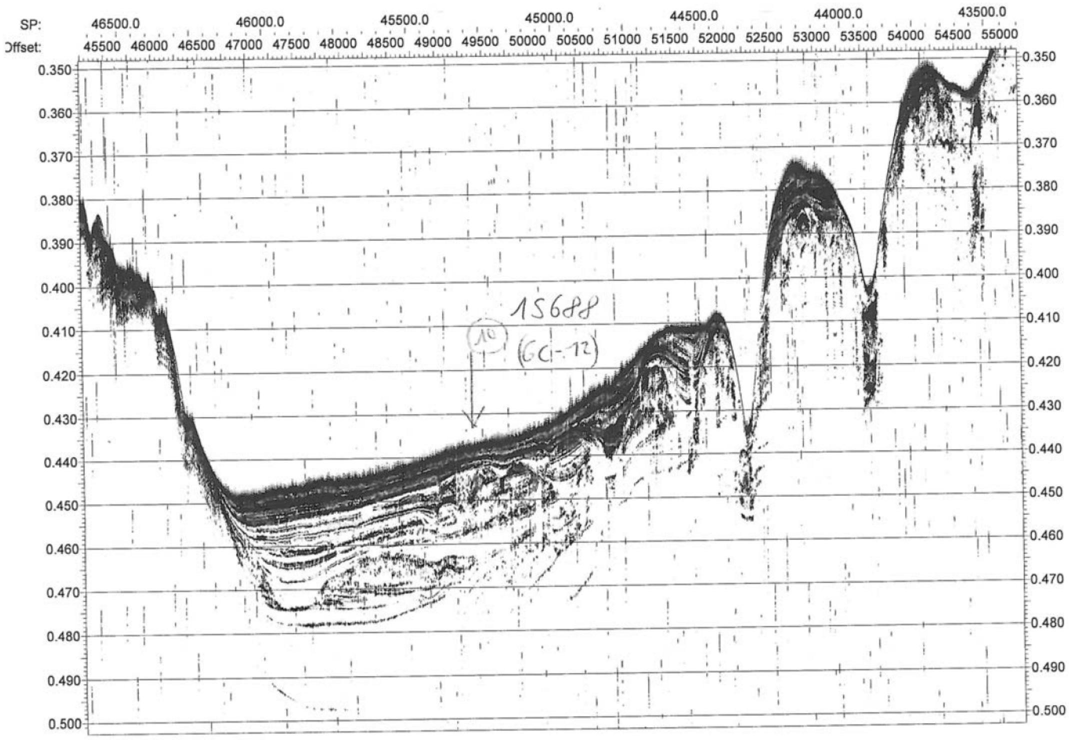

SP: 22000.0 22500.0 23000.0 23500.0 24000.0 24500.0 25000.0 25500.0
Offset: 44000 44500 45000 45500 46000 46500 47000 47500 48000 48500 49000 49500 50000 50500 51000
N
S
0.180
0.190
0.200
0.210
0.220
15682
(VC)
14
16
15681
(VC)

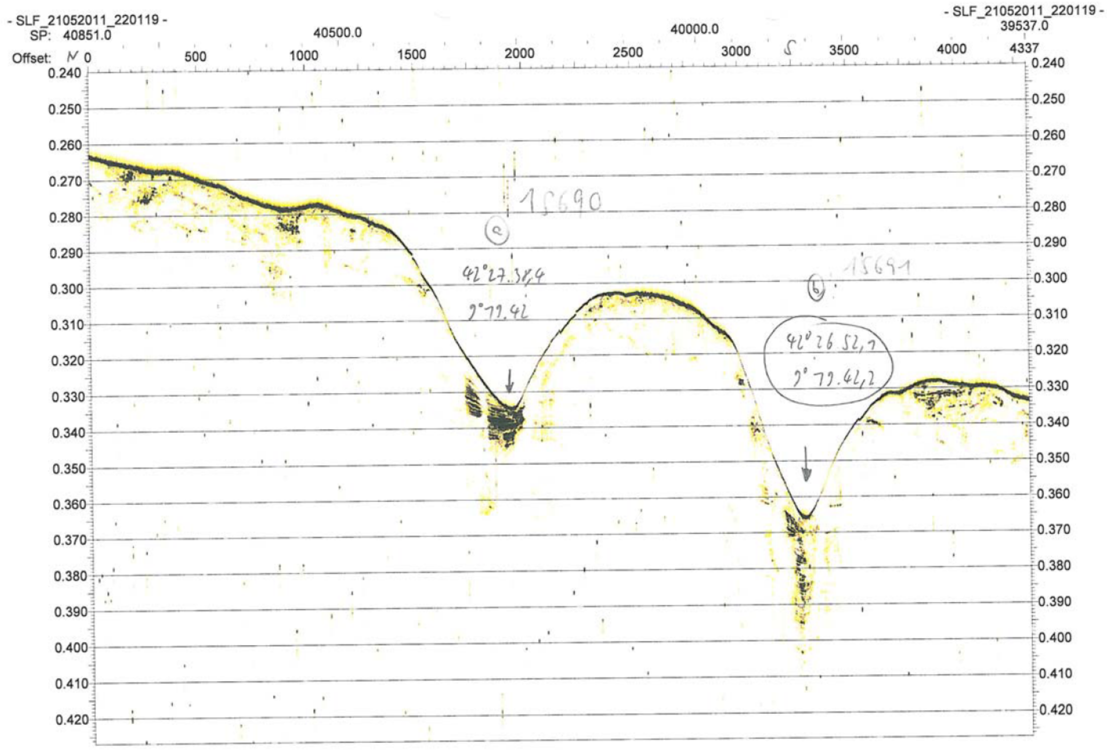

SP: 26613.0 27000.0 27500.0 28000.0 28500.0 29000.0 29500.0 30000.0
Offset: 0 500 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500 6000 6500 7000 7500
S
N
0.170
0.180
0.190
0.200
0.210
15
15683

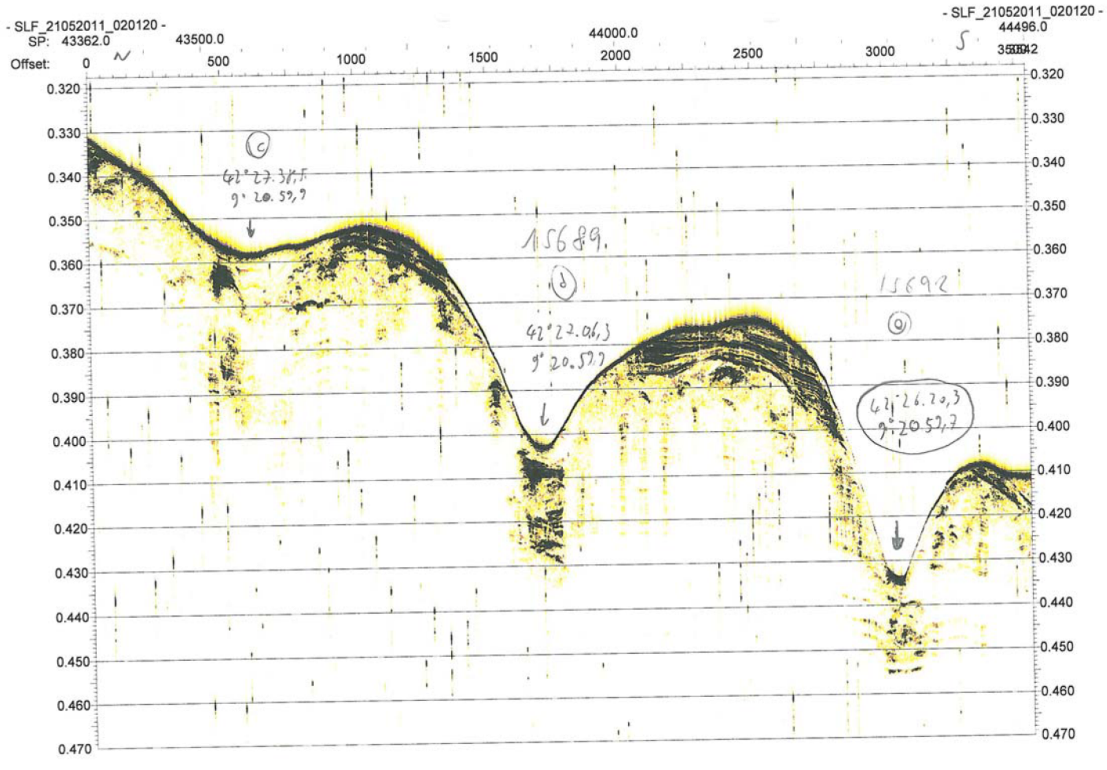

N
S
- SLF_22052011_210657 -
SP:
Offset:
17
15684
(VL)

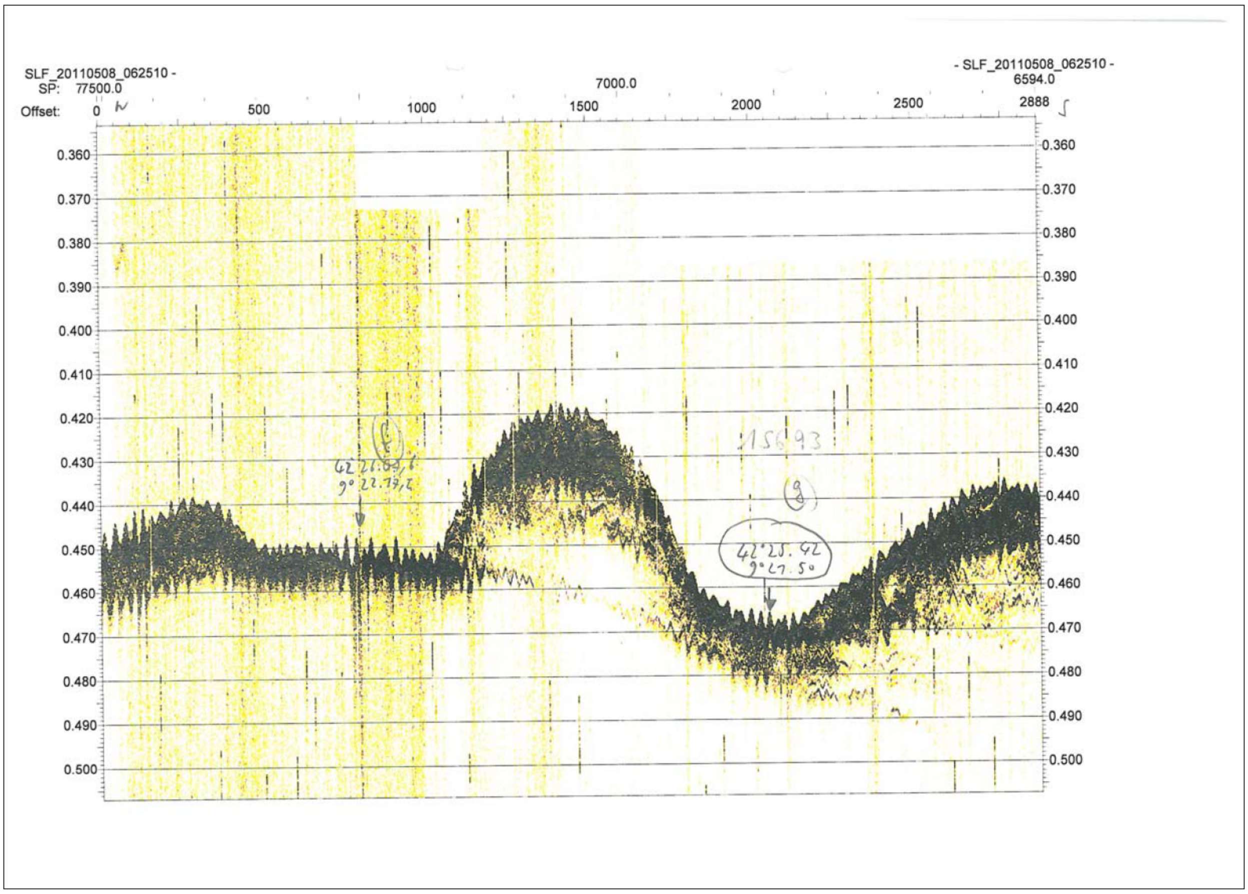

- SLF_22052011_170656 -
SP:
ffset:
15685 - 87


SP:
ffset:
13500.0
14000.0
26500
27000
27500
28000
28500
0.110
0.120
0.130
0.140
0.150
0.160
0.170
0.180
VL
VL
11 15687
(GC-6)
12 15686
(GC-7)
15685
13


SP:
Offset:
46500.0
46000.0
45500.0
45000.0
44500.0
44000.0
43500.0
45500 46000 46500 47000 47500 48000 48500 49000 49500 50000 50500 51000 51500 52000 52500 53000 53500 54000 54500 55000
0.350
0.360
0.370
0.380
0.390
0.400
0.410
0.420
0.430
0.440
0.450
0.460
0.470
0.480
0.490
0.500
15688
10
(GC-12)


- SLF_21052011_220119 -
SP: 40851.0
40500.0
40000.0
- SLF_21052011_220119 -
39537.0
Offset: N 0 500 1000 1500 2000 2500 3000 S 3500 4000 4337
0.240 0.250 0.260 0.270 0.280 0.290 0.300 0.310 0.320 0.330 0.340 0.350 0.360 0.370 0.380 0.390 0.400 0.410 0.420
15690
a
42°27.38,4
9°19.42
15691
b
42°26.52,1
9°19.42,2


- SLF_21052011_020120 -
SP: 43362.0
43500.0
44000.0
- SLF_21052011_020120 -
44496.0
Offset: 0 N 500 1000 1500 2000 2500 3000 S
0.320 0.330 0.340 0.350 0.360 0.370 0.380 0.390 0.400 0.410 0.420 0.430 0.440 0.450 0.460 0.470
c
42°27.38,5
9°20.59,9
15689.
d
42°27.06,3
9°20.57,7
15692
e
42°26.20,3
9°20.57,7


SLF_20110508_062510 -
SP: 77500.0
- SLF_20110508_062510 -
6594.0
7000.0
Offset: 0
500
1000
1500
2000
2500
2888
0.360
0.370
0.380
0.390
0.400
0.410
0.420
0.430
0.440
0.450
0.460
0.470
0.480
0.490
0.500

8 Data and Sample Storage and Availability

All sediment cores and samples are stored in the MARUM core repository. All data produced can be obtained from the respective research groups on request. Data sets which are part of publications will automatically be made publically available on www.pangaea.de.

9 Acknowledgements

We would like to thank the ship-owning company F. Laeisz and the Control Station German Research Vessels in Hamburg, especially for their support prior to the cruise. Captain Thomas Wunderlich and his crew have greatly contributed to the success of this cruise and we are very grateful for the outstanding communication, collaboration and nautical as well as technical expertise of his complete team.

We would like to acknowledge the significant support by our Spanish collaboration partners, Guillermo Frances, Javier Hernandez-Molina, Daniel Rey (all at the University of Vigo) and Gemma Ercilla (at the University of Barcelona). The *Instituto Hidrográfico de la Marina* has kindly provided the bathymetric data of the study area to Till Hanebuth and has, thus, very much helped to plan the cruise strategy with best efficiency. Further, we appreciate the good communication with and daily support by the Spanish coastal authorities who made possible our complex work in an area of intensive fishery activity.

We also would like to express our special thanks to the MARUM logistics group which has professionally organized the transfers of all equipment. The material obtained during research cruise M84/4 GALIOMAR III will be processed in the MARUM project SD2 "*External forcing and self-organization of clastic shelf systems*". The cruise and the following scientific work is part of the DFG Research Center/Excellence Cluster "*The Ocean in the Earth System*" at the University of Bremen. Cruise leader TH acknowledges a Heisenberg fellowship (HA 4317/4-1) by the German Research Foundation DFG.

Publications of this series:

No. 1 **Wefer, G., E. Suess and cruise participants**
Bericht über die POLARSTERN-Fahrt ANT IV/2, Rio de Janeiro - Punta Arenas, 6.11. - 1.12.1985.
60 pages, Bremen, 1986.

No. 2 **Hoffmann, G.**
Holozänstratigraphie und Küstenlinienverlagerung an der andalusischen Mittelmeerküste.
173 pages, Bremen, 1988. (out of print)

No. 3 **Wefer, G. and cruise participants**
Bericht über die METEOR-Fahrt M 6/6, Libreville - Las Palmas, 18.2. - 23.3.1988.
97 pages, Bremen, 1988.

No. 4 **Wefer, G., G.F. Lutze, T.J. Müller, O. Pfannkuche, W. Schenke, G. Siedler, W. Zenk**
Kurzbericht über die METEOR-Expedition No. 6, Hamburg - Hamburg, 28.10.1987 - 19.5.1988.
29 pages, Bremen, 1988. (out of print)

No. 5 **Fischer, G.**
Stabile Kohlenstoff-Isotope in partikulärer organischer Substanz aus dem Südpolarmeer (Atlantischer Sektor). 161 pages, Bremen, 1989.

No. 6 **Berger, W.H. and G. Wefer**
Partikelfluß und Kohlenstoffkreislauf im Ozean.
Bericht und Kurzfassungen über den Workshop vom 3.-4. Juli 1989 in Bremen.
57 pages, Bremen, 1989.

No. 7 **Wefer, G. and cruise participants**
Bericht über die METEOR - Fahrt M 9/4, Dakar - Santa Cruz, 19.2. - 16.3.1989.
103 pages, Bremen, 1989.

No. 8 **Kölling, M.**
Modellierung geochemischer Prozesse im Sickerwasser und Grundwasser.
135 pages, Bremen, 1990.

No. 9 **Heinze, P.-M.**
Das Auftriebsgeschehen vor Peru im Spätquartär. 204 pages, Bremen, 1990. (out of print)

No. 10 **Willems, H., G. Wefer, M. Rinski, B. Donner, H.-J. Bellmann, L. Eißmann, A. Müller, B.W. Flemming, H.-C. Höfle, J. Merkt, H. Streif, G. Hertweck, H. Kuntze, J. Schwaar, W. Schäfer, M.-G. Schulz, F. Grube, B. Menke**
Beiträge zur Geologie und Paläontologie Norddeutschlands: Exkursionsführer.
202 pages, Bremen, 1990.

No. 11 **Wefer, G. and cruise participants**
Bericht über die METEOR-Fahrt M 12/1, Kapstadt - Funchal, 13.3.1990 - 14.4.1990.
66 pages, Bremen, 1990.

No. 12 **Dahmke, A., H.D. Schulz, A. Kölling, F. Kracht, A. Lücke**
Schwermetallspuren und geochemische Gleichgewichte zwischen Porenlösung und Sediment im Wesermündungsgebiet. BMFT-Projekt MFU 0562, Abschlußbericht. 121 pages, Bremen, 1991.

No. 13 **Rostek, F.**
Physikalische Strukturen von Tiefseesedimenten des Südatlantiks und ihre Erfassung in Echolotregistrierungen. 209 pages, Bremen, 1991.

No. 14 **Baumann, M.**
Die Ablagerung von Tschernobyl-Radiocäsium in der Norwegischen See und in der Nordsee.
133 pages, Bremen, 1991. (out of print)

No. 15 **Kölling, A.**
Frühdiagenetische Prozesse und Stoff-Flüsse in marinen und ästuarinen Sedimenten.
140 pages, Bremen, 1991.

No. 16 **SFB 261 (ed.)**
1. Kolloquium des Sonderforschungsbereichs 261 der Universität Bremen (14.Juni 1991):
Der Südatlantik im Spätquartär: Rekonstruktion von Stoffhaushalt und Stromsystemen.
Kurzfassungen der Vorträge und Poster. 66 pages, Bremen, 1991.

No. 17 **Pätzold, J. and cruise participants**
Bericht und erste Ergebnisse über die METEOR-Fahrt M 15/2, Rio de Janeiro - Vitoria, 18.1. - 7.2.1991. 46 pages, Bremen, 1993.

No. 18 **Wefer, G. and cruise participants**
Bericht und erste Ergebnisse über die METEOR-Fahrt M 16/1, Pointe Noire - Recife, 27.3. - 25.4.1991. 120 pages, Bremen, 1991.

No. 19 **Schulz, H.D. and cruise participants**
Bericht und erste Ergebnisse über die METEOR-Fahrt M 16/2, Recife - Belem, 28.4. - 20.5.1991.
149 pages, Bremen, 1991.

No. 20 **Berner, H.**
Mechanismen der Sedimentbildung in der Fram-Straße, im Arktischen Ozean und in der Norwegischen See. 167 pages, Bremen, 1991.

No. 21 **Schneider, R.**
Spätquartäre Produktivitätsänderungen im östlichen Angola-Becken: Reaktion auf Variationen im Passat-Monsun-Windsystem und in der Advektion des Benguela-Küstenstroms. 198 pages, Bremen, 1991. (out of print)

No. 22 **Hebbeln, D.**
Spätquartäre Stratigraphie und Paläozeanographie in der Fram-Straße. 174 pages, Bremen, 1991.

No. 23 **Lücke, A.**
Umsetzungsprozesse organischer Substanz während der Frühdiagenese in ästuarinen Sedimenten. 137 pages, Bremen, 1991.

No. 24 **Wefer, G. and cruise participants**
Bericht und erste Ergebnisse der METEOR-Fahrt M 20/1, Bremen - Abidjan, 18.11.- 22.12.1991. 74 pages, Bremen, 1992.

No. 25 **Schulz, H.D. and cruise participants**
Bericht und erste Ergebnisse der METEOR-Fahrt M 20/2, Abidjan - Dakar, 27.12.1991 - 3.2.1992. 173 pages, Bremen, 1992.

No. 26 **Gingele, F.**
Zur klimaabhängigen Bildung biogener und terrigener Sedimente und ihrer Veränderung durch die Frühdiagenese im zentralen und östlichen Südatlantik. 202 pages, Bremen, 1992.

No. 27 **Bickert, T.**
Rekonstruktion der spätquartären Bodenwasserzirkulation im östlichen Südatlantik über stabile Isotope benthischer Foraminiferen. 205 pages, Bremen, 1992. (out of print)

No. 28 **Schmidt, H.**
Der Benguela-Strom im Bereich des Walfisch-Rückens im Spätquartär. 172 pages, Bremen, 1992.

No. 29 **Meinecke, G.**
Spätquartäre Oberflächenwassertemperaturen im östlichen äquatorialen Atlantik. 181 pages, Bremen, 1992.

No. 30 **Bathmann, U., U. Bleil, A. Dahmke, P. Müller, A. Nehrkorn, E.-M. Nöthig, M. Olesch, J. Pätzold, H.D. Schulz, V. Smetacek, V. Spieß, G. Wefer, H. Willems**
Bericht des Graduierten Kollegs. Stoff-Flüsse in marinen Geosystemen. Berichtszeitraum Oktober 1990 - Dezember 1992. 396 pages, Bremen, 1992.

No. 31 **Damm, E.**
Frühdiagenetische Verteilung von Schwermetallen in Schlicksedimenten der westlichen Ostsee. 115 pages, Bremen, 1992.

No. 32 **Antia, E.E.**
Sedimentology, Morphodynamics and Facies Association of a mesotidal Barrier Island Shoreface (Spiekeroog, Southern North Sea). 370 pages, Bremen, 1993.

No. 33 **Duinker, J. and G. Wefer (ed.)**
Bericht über den 1. JGOFS-Workshop. 1./2. Dezember 1992 in Bremen. 83 pages, Bremen, 1993.

No. 34 **Kasten, S.**
Die Verteilung von Schwermetallen in den Sedimenten eines stadtbremischen Hafenbeckens. 103 pages, Bremen, 1993.

No. 35 **Spieß, V.**
Digitale Sedimentographie. Neue Wege zu einer hochauflösenden Akustostratigraphie. 199 pages, Bremen, 1993.

No. 36 **Schinzel, U.**
Laborversuche zu frühdiagenetischen Reaktionen von Eisen (III) - Oxidhydraten in marinen Sedimenten.189 pages, Bremen, 1993.

No. 37 **Sieger, R.**
CoTAM - ein Modell zur Modellierung des Schwermetalltransports in Grundwasserleitern. 56 pages, Bremen, 1993. (out of print)

No. 38 **Willems, H. (ed.)**
Geoscientific Investigations in the Tethyan Himalayas. 183 pages, Bremen, 1993.

No. 39 **Hamer, K.**
Entwicklung von Laborversuchen als Grundlage für die Modellierung des Transportverhaltens von Arsenat, Blei, Cadmium und Kupfer in wassergesättigten Säulen. 147 pages, Bremen, 1993.

No. 40 **Sieger, R.**
Modellierung des Stofftransports in porösen Medien unter Ankopplung kinetisch gesteuerter Sorptions- und Redoxprozesse sowie thermischer Gleichgewichte. 158 pages, Bremen, 1993.

No. 41 **Thießen, W.**
Magnetische Eigenschaften von Sedimenten des östlichen Südatlantiks und ihre paläozeanographische Relevanz. 170 pages, Bremen, 1993.

No. 42 **Spieß, V. and cruise participants**
Report and preliminary results of METEOR-Cruise M 23/1, Kapstadt - Rio de Janeiro, 4.-25.2.1993. 139 pages, Bremen, 1994.

No. 43 **Bleil, U. and cruise participants**
Report and preliminary results of METEOR-Cruise M 23/2, Rio de Janeiro - Recife, 27.2.-19.3.1993 133 pages, Bremen, 1994.

No. 44 **Wefer, G. and cruise participants**
Report and preliminary results of METEOR-Cruise M 23/3, Recife - Las Palmas, 21.3. - 12.4.1993 71 pages, Bremen, 1994.

No. 45 **Giese, M. and G. Wefer (ed.)**
Bericht über den 2. JGOFS-Workshop. 18../19. November 1993 in Bremen.
93 pages, Bremen, 1994.

No. 46 **Balzer, W. and cruise participants**
Report and preliminary results of METEOR-Cruise M 22/1, Hamburg - Recife, 22.9. - 21.10.1992. 24 pages, Bremen, 1994.

No. 47 **Stax, R.**
Zyklische Sedimentation von organischem Kohlenstoff in der Japan See: Anzeiger für Änderungen von Paläoozeanographie und Paläoklima im Spätkänozoikum.
150 pages, Bremen, 1994.

No. 48 **Skowronek, F.**
Frühdiagenetische Stoff-Flüsse gelöster Schwermetalle an der Oberfläche von Sedimenten des Weser Ästuares. 107 pages, Bremen, 1994.

No. 49 **Dersch-Hansmann, M.**
Zur Klimaentwicklung in Ostasien während der letzten 5 Millionen Jahre:
Terrigener Sedimenteintrag in die Japan See (ODP Ausfahrt 128). 149 pages, Bremen, 1994.

No. 50 **Zabel, M.**
Frühdiagenetische Stoff-Flüsse in Oberflächen-Sedimenten des äquatorialen und östlichen Südatlantik. 129 pages, Bremen, 1994.

No. 51 **Bleil, U. and cruise participants**
Report and preliminary results of SONNE-Cruise SO 86, Buenos Aires - Capetown, 22.4. - 31.5.93 116 pages, Bremen, 1994.

No. 52 **Symposium: The South Atlantic: Present and Past Circulation.**
Bremen, Germany, 15 - 19 August 1994. Abstracts. 167 pages, Bremen, 1994.

No. 53 **Kretzmann, U.B.**
57Fe-Mössbauer-Spektroskopie an Sedimenten - Möglichkeiten und Grenzen.
183 pages, Bremen, 1994.

No. 54 **Bachmann, M.**
Die Karbonatrampe von Organyà im oberen Oberapt und unteren Unteralb (NE-Spanien, Prov. Lerida): Fazies, Zyklo- und Sequenzstratigraphie. 147 pages, Bremen, 1994. (out of print)

No. 55 **Kemle-von Mücke, S.**
Oberflächenwasserstruktur und -zirkulation des Südostatlantiks im Spätquartär.
151 pages, Bremen, 1994.

No. 56 **Petermann, H.**
Magnetotaktische Bakterien und ihre Magnetosome in Oberflächensedimenten des Südatlantiks.
134 pages, Bremen, 1994.

No. 57 **Mulitza, S.**
Spätquartäre Variationen der oberflächennahen Hydrographie im westlichen äquatorialen Atlantik.
97 pages, Bremen, 1994.

No. 58 **Segl, M. and cruise participants**
Report and preliminary results of METEOR-Cruise M 29/1, Buenos-Aires - Montevideo,
17.6. - 13.7.1994
94 pages, Bremen, 1994.

No. 59 **Bleil, U. and cruise participants**
Report and preliminary results of METEOR-Cruise M 29/2, Montevideo - Rio de Janiero
15.7. - 8.8.1994. 153 pages, Bremen, 1994.

No. 60 **Henrich, R. and cruise participants**
Report and preliminary results of METEOR-Cruise M 29/3, Rio de Janeiro - Las Palmas
11.8. - 5.9.1994. Bremen, 1994. (out of print)

No. 61 **Sagemann, J.**
Saisonale Variationen von Porenwasserprofilen, Nährstoff-Flüssen und Reaktionen in intertidalen Sedimenten des Weser-Ästuars. 110 pages, Bremen, 1994. (out of print)

No. 62 **Giese, M. and G. Wefer**
Bericht über den 3. JGOFS-Workshop. 5./6. Dezember 1994 in Bremen. 84 pages, Bremen, 1995.

No. 63 **Mann, U.**
Genese kretazischer Schwarzschiefer in Kolumbien: Globale vs. regionale/lokale Prozesse. 153 pages, Bremen, 1995. (out of print)

No. 64 **Willems, H., Wan X., Yin J., Dongdui L., Liu G., S. Dürr, K.-U. Gräfe**
The Mesozoic development of the N-Indian passive margin and of the Xigaze Forearc Basin in southern Tibet, China. – Excursion Guide to IGCP 362 Working-Group Meeting "Integrated Stratigraphy". 113 pages, Bremen, 1995. (out of print)

No. 65 **Hünken, U.**
Liefergebiets - Charakterisierung proterozoischer Goldseifen in Ghana anhand von Fluideinschluß - Untersuchungen. 270 pages, Bremen, 1995.

No. 66 **Nyandwi, N.**
The Nature of the Sediment Distribution Patterns in ther Spiekeroog Backbarrier Area, the East Frisian Islands. 162 pages, Bremen, 1995.

No. 67 **Isenbeck-Schröter, M.**
Transportverhalten von Schwermetallkationen und Oxoanionen in wassergesättigten Sanden. - Laborversuche in Säulen und ihre Modellierung -. 182 pages, Bremen, 1995.

No. 68 **Hebbeln, D. and cruise participants**
Report and preliminary results of SONNE-Cruise SO 102, Valparaiso - Valparaiso, 95. 134 pages, Bremen, 1995.

No. 69 **Willems, H. (Sprecher), U.Bathmann, U. Bleil, T. v. Dobeneck, K. Herterich, B.B. Jorgensen, E.-M. Nöthig, M. Olesch, J. Pätzold, H.D. Schulz, V. Smetacek, V. Speiß. G. Wefer**
Bericht des Graduierten-Kollegs Stoff-Flüsse in marine Geosystemen. Berichtszeitraum Januar 1993 - Dezember 1995. 45 & 468 pages, Bremen, 1995.

No. 70 **Giese, M. and G. Wefer**
Bericht über den 4. JGOFS-Workshop. 20./21. November 1995 in Bremen. 60 pages, Bremen, 1996. (out of print)

No. 71 **Meggers, H.**
Pliozän-quartäre Karbonatsedimentation und Paläozeanographie des Nordatlantiks und des Europäischen Nordmeeres - Hinweise aus planktischen Foraminiferengemeinschaften. 143 pages, Bremen, 1996. (out of print)

No. 72 **Teske, A.**
Phylogenetische und ökologische Untersuchungen an Bakterien des oxidativen und reduktiven marinen Schwefelkreislaufs mittels ribosomaler RNA. 220 pages, Bremen, 1996. (out of print)

No. 73 **Andersen, N.**
Biogeochemische Charakterisierung von Sinkstoffen und Sedimenten aus ostatlantischen Produktions-Systemen mit Hilfe von Biomarkern. 215 pages, Bremen, 1996.

No. 74 **Treppke, U.**
Saisonalität im Diatomeen- und Silikoflagellatenfluß im östlichen tropischen und subtropischen Atlantik. 200 pages, Bremen, 1996.

No. 75 **Schüring, J.**
Die Verwendung von Steinkohlebergematerialien im Deponiebau im Hinblick auf die Pyritverwitterung und die Eignung als geochemische Barriere. 110 pages, Bremen, 1996.

No. 76 **Pätzold, J. and cruise participants**
Report and preliminary results of VICTOR HENSEN cruise JOPS II, Leg 6, Fortaleza - Recife, 10.3. - 26.3. 1995 and Leg 8, Vítoria - Vítoria, 10.4. - 23.4.1995. 87 pages, Bremen, 1996.

No. 77 **Bleil, U. and cruise participants**
Report and preliminary results of METEOR-Cruise M 34/1, Cape Town - Walvis Bay, 3.-26.1.1996. 129 pages, Bremen, 1996.

No. 78 **Schulz, H.D. and cruise participants**
Report and preliminary results of METEOR-Cruise M 34/2, Walvis Bay - Walvis Bay, 29.1.-18.2.96 133 pages, Bremen, 1996.

No. 79 **Wefer, G. and cruise participants**
Report and preliminary results of METEOR-Cruise M 34/3, Walvis Bay - Recife, 21.2.-17.3.1996. 168 pages, Bremen, 1996.

No. 80 **Fischer, G. and cruise participants**
Report and preliminary results of METEOR-Cruise M 34/4, Recife - Bridgetown, 19.3.-15.4.1996.
105 pages, Bremen, 1996.

No. 81 **Kulbrok, F.**
Biostratigraphie, Fazies und Sequenzstratigraphie einer Karbonatrampe in den Schichten der Oberkreide und des Alttertiärs Nordost-Ägyptens (Eastern Desert, N'Golf von Suez, Sinai).
153 pages, Bremen, 1996.

No. 82 **Kasten, S.**
Early Diagenetic Metal Enrichments in Marine Sediments as Documents of Nonsteady-State Depositional Conditions. Bremen, 1996.

No. 83 **Holmes, M.E.**
Reconstruction of Surface Ocean Nitrate Utilization in the Southeast Atlantic Ocean Based on Stable Nitrogen Isotopes. 113 pages, Bremen, 1996.

No. 84 **Rühlemann, C.**
Akkumulation von Carbonat und organischem Kohlenstoff im tropischen Atlantik:
Spätquartäre Produktivitäts-Variationen und ihre Steuerungsmechanismen. 139 pages, Bremen, 1996.

No. 85 **Ratmeyer, V.**
Untersuchungen zum Eintrag und Transport lithogener und organischer partikulärer Substanz im östlichen subtropischen Nordatlantik. 154 pages, Bremen, 1996.

No. 86 **Cepek, M.**
Zeitliche und räumliche Variationen von Coccolithophoriden-Gemeinschaften im subtropischen Ost-Atlantik: Untersuchungen an Plankton, Sinkstoffen und Sedimenten. 156 pages, Bremen, 1996.

No. 87 **Otto, S.**
Die Bedeutung von gelöstem organischen Kohlenstoff (DOC) für den Kohlenstofffluß im Ozean.
150 pages, Bremen, 1996.

No. 88 **Hensen, C.**
Frühdiagenetische Prozesse und Quantifizierung benthischer Stoff-Flüsse in Oberflächensedimenten des Südatlantiks. 132 pages, Bremen, 1996.

No. 89 **Giese, M. and G. Wefer**
Bericht über den 5. JGOFS-Workshop. 27./28. November 1996 in Bremen. 73 pages, Bremen, 1997.

No. 90 **Wefer, G. and cruise participants**
Report and preliminary results of METEOR-Cruise M 37/1, Lisbon - Las Palmas, 4.-23.12.1996.
79 pages, Bremen, 1997.

No. 91 **Isenbeck-Schröter, M., E. Bedbur, M. Kofod, B. König, T. Schramm & G. Mattheß**
Occurrence of Pesticide Residues in Water - Assessment of the Current Situation in Selected EU Countries. 65 pages, Bremen 1997.

No. 92 **Kühn, M.**
Geochemische Folgereaktionen bei der hydrogeothermalen Energiegewinnung. 129 pages, Bremen 1997.

No. 93 **Determann, S. & K. Herterich**
JGOFS-A6 "Daten und Modelle": Sammlung JGOFS-relevanter Modelle in Deutschland.
26 pages, Bremen, 1997.

No. 94 **Fischer, G. and cruise participants**
Report and preliminary results of METEOR-Cruise M 38/1, Las Palmas - Recife, 25.1.-1.3.1997, with Appendix: Core Descriptions from METEOR Cruise M 37/1. Bremen, 1997.

No. 95 **Bleil, U. and cruise participants**
Report and preliminary results of METEOR-Cruise M 38/2, Recife - Las Palmas, 4.3.-14.4.1997.
126 pages, Bremen, 1997.

No. 96 **Neuer, S. and cruise participants**
Report and preliminary results of VICTOR HENSEN-Cruise 96/1. Bremen, 1997.

No. 97 **Villinger, H. and cruise participants**
Fahrtbericht SO 111, 20.8. - 16.9.1996. 115 pages, Bremen, 1997.

No. 98 **Lüning, S.**
Late Cretaceous - Early Tertiary sequence stratigraphy, paleoecology and geodynamics of Eastern Sinai, Egypt. 218 pages, Bremen, 1997.

No. 99 **Haese, R.R.**
Beschreibung und Quantifizierung frühdiagenetischer Reaktionen des Eisens in Sedimenten des Südatlantiks. 118 pages, Bremen, 1997.

No. 100 **Lührte, R. von**
Verwertung von Bremer Baggergut als Material zur Oberflächenabdichtung von Deponien - Geochemisches Langzeitverhalten und Schwermetall-Mobilität (Cd, Cu, Ni, Pb, Zn). Bremen, 1997.

No. 101 **Ebert, M.**
Der Einfluß des Redoxmilieus auf die Mobilität von Chrom im durchströmten Aquifer. 135 pages, Bremen, 1997.

No. 102 **Krögel, F.**
Einfluß von Viskosität und Dichte des Seewassers auf Transport und Ablagerung von Wattsedimenten (Langeooger Rückseitenwatt, südliche Nordsee). 168 pages, Bremen, 1997.

No. 103 **Kerntopf, B.**
Dinoflagellate Distribution Patterns and Preservation in the Equatorial Atlantic and Offshore North-West Africa. 137 pages, Bremen, 1997.

No. 104 **Breitzke, M.**
Elastische Wellenausbreitung in marinen Sedimenten - Neue Entwicklungen der Ultraschall Sedimentphysik und Sedimentechographie. 298 pages, Bremen, 1997.

No. 105 **Marchant, M.**
Rezente und spätquartäre Sedimentation planktischer Foraminiferen im Peru-Chile Strom. 115 pages, Bremen, 1997.

No. 106 **Habicht, K.S.**
Sulfur isotope fractionation in marine sediments and bacterial cultures. 125 pages, Bremen, 1997.

No. 107 **Hamer, K., R.v. Lührte, G. Becker, T. Felis, S. Keffel, B. Strotmann, C. Waschkowitz, M. Kölling, M. Isenbeck-Schröter, H.D. Schulz**
Endbericht zum Forschungsvorhaben 060 des Landes Bremen: Baggergut der Hafengruppe Bremen-Stadt: Modelluntersuchungen zur Schwermetallmobilität und Möglichkeiten der Verwertung von Hafenschlick aus Bremischen Häfen. 98 pages, Bremen, 1997.

No. 108 **Greeff, O.W.**
Entwicklung und Erprobung eines benthischen Landersystemes zur in situ-Bestimmung von Sulfatreduktionsraten mariner Sedimente. 121 pages, Bremen, 1997.

No. 109 **Pätzold, M. und G. Wefer**
Bericht über den 6. JGOFS-Workshop am 4./5.12.1997 in Bremen. Im Anhang: Publikationen zum deutschen Beitrag zur Joint Global Ocean Flux Study (JGOFS), Stand 1/1998. 122 pages, Bremen, 1998.

No. 110 **Landenberger, H.**
CoTReM, ein Multi-Komponenten Transport- und Reaktions-Modell. 142 pages, Bremen, 1998.

No. 111 **Villinger, H. und Fahrtteilnehmer**
Fahrtbericht SO 124, 4.10. - 16.10.199. 90 pages, Bremen, 1997.

No. 112 **Gietl, R.**
Biostratigraphie und Sedimentationsmuster einer nordostägyptischen Karbonatrampe unter Berücksichtigung der Alveolinen-Faunen. 142 pages, Bremen, 1998.

No. 113 **Ziebis, W.**
The Impact of the Thalassinidean Shrimp Callianassa truncata on the Geochemistry of permeable, coastal Sediments. 158 pages, Bremen 1998.

No. 114 **Schulz, H.D. and cruise participants**
Report and preliminary results of METEOR-Cruise M 41/1, Málaga - Libreville, 13.2.-15.3.1998. Bremen, 1998.

No. 115 **Völker, D.J.**
Untersuchungen an strömungsbeeinflußten Sedimentationsmustern im Südozean. Interpretation sedimentechographischer Daten und numerische Modellierung. 152 pages, Bremen, 1998.

No. 116 **Schlünz, B.**
Riverine Organic Carbon Input into the Ocean in Relation to Late Quaternary Climate Change. 136 pages, Bremen, 1998.

No. 117 **Kuhnert, H.**
Aufzeichnug des Klimas vor Westaustralien in stabilen Isotopen in Korallenskeletten. 109 pages, Bremen, 1998.

No. 118 **Kirst, G.**
Rekonstruktion von Oberflächenwassertemperaturen im östlichen Südatlantik anhand von Alkenonen. 130 pages, Bremen, 1998.

No. 119 **Dürkoop, A.**
Der Brasil-Strom im Spätquartär: Rekonstruktion der oberflächennahen Hydrographie während der letzten 400 000 Jahre. 121 pages, Bremen, 1998.

No. 120 **Lamy, F.**
Spätquartäre Variationen des terrigenen Sedimenteintrags entlang des chilenischen Kontinentalhangs als Abbild von Klimavariabilität im Milanković- und Sub-Milanković-Zeitbereich. 141 pages, Bremen, 1998.

No. 121 **Neuer, S. and cruise participants**
Report and preliminary results of POSEIDON-Cruise Pos 237/2, Vigo – Las Palmas, 18.3.-31.3.1998. 39 pages, Bremen, 1998

No. 122 **Romero, O.E.**
Marine planktonic diatoms from the tropical and equatorial Atlantic: temporal flux patterns and the sediment record. 205 pages, Bremen, 1998.

No. 123 **Spiess, V. und Fahrtteilnehmer**
Report and preliminary results of RV SONNE Cruise 125, Cochin – Chittagong, 17.10.-17.11.1997. 128 pages, Bremen, 1998.

No. 124 **Arz, H.W.**
Dokumentation von kurzfristigen Klimaschwankungen des Spätquartärs in Sedimenten des westlichen äquatorialen Atlantiks. 96 pages, Bremen, 1998.

No. 125 **Wolff, T.**
Mixed layer characteristics in the equatorial Atlantic during the late Quaternary as deduced from planktonic foraminifera. 132 pages, Bremen, 1998.

No. 126 **Dittert, N.**
Late Quaternary Planktic Foraminifera Assemblages in the South Atlantic Ocean: Quantitative Determination and Preservational Aspects. 165 pages, Bremen, 1998.

No. 127 **Höll, C.**
Kalkige und organisch-wandige Dinoflagellaten-Zysten in Spätquartären Sedimenten des tropischen Atlantiks und ihre palökologische Auswertbarkeit. 121 pages, Bremen, 1998.

No. 128 **Hencke, J.**
Redoxreaktionen im Grundwasser: Etablierung und Verlagerung von Reaktionsfronten und ihre Bedeutung für die Spurenelement-Mobilität. 122 pages, Bremen 1998.

No. 129 **Pätzold, J. and cruise participants**
Report and preliminary results of METEOR-Cruise M 41/3, Vítoria, Brasil – Salvador de Bahia, Brasil, 18.4. - 15.5.1998. Bremen, 1999.

No. 130 **Fischer, G. and cruise participants**
Report and preliminary results of METEOR-Cruise M 41/4, Salvador de Bahia, Brasil – Las Palmas, Spain, 18.5. – 13.6.1998. Bremen, 1999.

No. 131 **Schlünz, B. und G. Wefer**
Bericht über den 7. JGOFS-Workshop am 3. und 4.12.1998 in Bremen. Im Anhang: Publikationen zum deutschen Beitrag zur Joint Global Ocean Flux Study (JGOFS), Stand 1/ 1999. 100 pages, Bremen, 1999.

No. 132 **Wefer, G. and cruise participants**
Report and preliminary results of METEOR-Cruise M 42/4, Las Palmas - Las Palmas - Viena do Castelo; 26.09.1998 - 26.10.1998. 104 pages, Bremen, 1999.

No. 133 **Felis, T.**
Climate and ocean variability reconstructed from stable isotope records of modern subtropical corals (Northern Red Sea). 111 pages, Bremen, 1999.

No. 134 **Draschba , S.**
North Atlantic climate variability recorded in reef corals from Bermuda. 108 pages, Bremen, 1999.

No. 135 **Schmieder, F.**
Magnetic Cyclostratigraphy of South Atlantic Sediments. 82 pages, Bremen, 1999.

No. 136 **Rieß, W.**
In situ measurements of respiration and mineralisation processes – Interaction between fauna and geochemical fluxes at active interfaces. 68 pages, Bremen, 1999.

No. 137 **Devey, C.W. and cruise participants**
Report and shipboard results from METEOR-cruise M 41/2, Libreville – Vitoria, 18.3. – 15.4.98. 59 pages, Bremen, 1999.

No. 138 **Wenzhöfer, F.**
Biogeochemical processes at the sediment water interface and quantification of metabolically driven calcite dissolution in deep sea sediments. 103 pages, Bremen, 1999.

No. 139 **Klump, J.**
Biogenic barite as a proxy of paleoproductivity variations in the Southern Peru-Chile Current. 107 pages, Bremen, 1999.

No. 140 **Huber, R.**
Carbonate sedimentation in the northern Northatlantic since the late pliocene. 103 pages, Bremen, 1999.

No. 141 **Schulz, H.**
Nitrate-storing sulfur bacteria in sediments of coastal upwelling. 94 pages, Bremen, 1999.

No. 142 **Mai, S.**
Die Sedimentverteilung im Wattenmeer: ein Simulationsmodell. 114 pages, Bremen, 1999.

No. 143 **Neuer, S. and cruise participants**
Report and preliminary results of Poseidon Cruise 248, Las Palmas - Las Palmas, 15.2.-26.2.1999. 45 pages, Bremen, 1999.

No. 144 **Weber, A.**
Schwefelkreislauf in marinen Sedimenten und Messung von in situ Sulfatreduktionsraten. 122 pages, Bremen, 1999.

No. 145 **Hadeler, A.**
Sorptionsreaktionen im Grundwasser: Unterschiedliche Aspekte bei der Modellierung des Transportverhaltens von Zink. 122 pages, 1999.

No. 146 **Dierßen, H.**
Zum Kreislauf ausgewählter Spurenmetalle im Südatlantik: Vertikaltransport und Wechselwirkung zwischen Partikeln und Lösung. 167 pages, Bremen, 1999.

No. 147 **Zühlsdorff, L.**
High resolution multi-frequency seismic surveys at the Eastern Juan de Fuca Ridge Flank and the Cascadia Margin – Evidence for thermally and tectonically driven fluid upflow in marine sediments. 118 pages, Bremen 1999.

No. 148 **Kinkel, H.**
Living and late Quaternary Coccolithophores in the equatorial Atlantic Ocean: response of distribution and productivity patterns to changing surface water circulation. 183 pages, Bremen, 2000.

No. 149 **Pätzold, J. and cruise participants**
Report and preliminary results of METEOR Cruise M 44/3, Aqaba (Jordan) - Safaga (Egypt) – Dubá (Saudi Arabia) – Suez (Egypt) - Haifa (Israel), 12.3.-26.3.-2.4.-4.4.1999. 135 pages, Bremen, 2000.

No. 150 **Schlünz, B. and G. Wefer**
Bericht über den 8. JGOFS-Workshop am 2. und 3.12.1999 in Bremen. Im Anhang: Publikationen zum deutschen Beitrag zur Joint Global Ocean Flux Study (JGOFS), Stand 1/ 2000. 95 pages, Bremen, 2000.

No. 151 **Schnack, K.**
Biostratigraphie und fazielle Entwicklung in der Oberkreide und im Alttertiär im Bereich der Kharga Schwelle, Westliche Wüste, SW-Ägypten. 142 pages, Bremen, 2000.

No. 152 **Karwath, B.**
Ecological studies on living and fossil calcareous dinoflagellates of the equatorial and tropical Atlantic Ocean. 175 pages, Bremen, 2000.

No. 153 **Moustafa, Y.**
Paleoclimatic reconstructions of the Northern Red Sea during the Holocene inferred from stable isotope records of modern and fossil corals and molluscs. 102 pages, Bremen, 2000.

No. 154 **Villinger, H. and cruise participants**
Report and preliminary results of SONNE-cruise 145-1 Balboa – Talcahuana, 21.12.1999 – 28.01.2000. 147 pages, Bremen, 2000.

No. 155 **Rusch, A.**
Dynamik der Feinfraktion im Oberflächenhorizont permeabler Schelfsedimente. 102 pages, Bremen, 2000.

No. 156 **Moos, C.**
Reconstruction of upwelling intensity and paleo-nutrient gradients in the northwest Arabian Sea derived from stable carbon and oxygen isotopes of planktic foraminifera. 103 pages, Bremen, 2000.

No. 157 **Xu, W.**
Mass physical sediment properties and trends in a Wadden Sea tidal basin. 127 pages, Bremen, 2000.

No. 158 **Meinecke, G. and cruise participants**
Report and preliminary results of METEOR Cruise M 45/1, Malaga (Spain) - Lissabon (Portugal), 19.05. - 08.06.1999. 39 pages, Bremen, 2000.

No. 159 **Vink, A.**
Reconstruction of recent and late Quaternary surface water masses of the western subtropical Atlantic Ocean based on calcareous and organic-walled dinoflagellate cysts. 160 pages, Bremen, 2000.

No. 160 **Willems, H. (Sprecher), U. Bleil, R. Henrich, K. Herterich, B.B. Jørgensen, H.-J. Kuß, M. Olesch, H.D. Schulz,V. Spieß, G. Wefer**
Abschlußbericht des Graduierten-Kollegs Stoff-Flüsse in marine Geosystemen. Zusammenfassung und Berichtszeitraum Januar 1996 - Dezember 2000. 340 pages, Bremen, 2000.

No. 161 **Sprengel, C.**
Untersuchungen zur Sedimentation und Ökologie von Coccolithophoriden im Bereich der Kanarischen Inseln: Saisonale Flussmuster und Karbonatexport. 165 pages, Bremen, 2000.

No. 162 **Donner, B. and G. Wefer**
Bericht über den JGOFS-Workshop am 18.-21.9.2000 in Bremen: Biogeochemical Cycles: German Contributions to the International Joint Global Ocean Flux Study. 87 pages, Bremen, 2000.

No. 163 **Neuer, S. and cruise participants**
Report and preliminary results of Meteor Cruise M 45/5, Bremen – Las Palmas, October 1 – November 3, 1999. 93 pages, Bremen, 2000.

No. 164 **Devey, C. and cruise participants**
Report and preliminary results of Sonne Cruise SO 145/2, Talcahuano (Chile) - Arica (Chile), February 4 – February 29, 2000. 63 pages, Bremen, 2000.

No. 165 **Freudenthal, T.**
Reconstruction of productivity gradients in the Canary Islands region off Morocco by means of sinking particles and sediments. 147 pages, Bremen, 2000.

No. 166 **Adler, M.**
Modeling of one-dimensional transport in porous media with respect to simultaneous geochemical reactions in CoTReM. 147 pages, Bremen, 2000.

No. 167 **Santamarina Cuneo, P.**
Fluxes of suspended particulate matter through a tidal inlet of the East Frisian Wadden Sea (southern North Sea). 91 pages, Bremen, 2000.

No. 168 **Benthien, A.**
Effects of CO2 and nutrient concentration on the stable carbon isotope composition of C37:2 alkenones in sediments of the South Atlantic Ocean. 104 pages, Bremen, 2001.

No. 169 **Lavik, G.**
Nitrogen isotopes of sinking matter and sediments in the South Atlantic. 140 pages, Bremen, 2001.

No. 170 **Budziak, D.**
Late Quaternary monsoonal climate and related variations in paleoproductivity and alkenone-derived sea-surface temperatures in the western Arabian Sea. 114 pages, Bremen, 2001.

No. 171 **Gerhardt, S.**
Late Quaternary water mass variability derived from the pteropod preservation state in sediments of the western South Atlantic Ocean and the Caribbean Sea. 109 pages, Bremen, 2001.

No. 172 **Bleil, U. and cruise participants**
Report and preliminary results of Meteor Cruise M 46/3, Montevideo (Uruguay) – Mar del Plata (Argentina), January 4 – February 7, 2000. Bremen, 2001.

No. 173 **Wefer, G. and cruise participants**
Report and preliminary results of Meteor Cruise M 46/4, Mar del Plata (Argentina) – Salvador da Bahia (Brazil), February 10 – March 13, 2000. With partial results of METEOR cruise M 46/2. 136 pages, Bremen, 2001.

No. 174 **Schulz, H.D. and cruise participants**
Report and preliminary results of Meteor Cruise M 46/2, Recife (Brazil) – Montevideo (Uruguay), December 2 – December 29, 1999. 107 pages, Bremen, 2001.

No. 175 **Schmidt, A.**
Magnetic mineral fluxes in the Quaternary South Atlantic: Implications for the paleoenvironment. 97 pages, Bremen, 2001.

No. 176 **Bruhns, P.**
Crystal chemical characterization of heavy metal incorporation in brick burning processes. 93 pages, Bremen, 2001.

No. 177 **Karius, V.**
Baggergut der Hafengruppe Bremen-Stadt in der Ziegelherstellung. 131 pages, Bremen, 2001.

No. 178 **Adegbie, A. T.**
Reconstruction of paleoenvironmental conditions in Equatorial Atlantic and the Gulf of Guinea Basins for the last 245,000 years. 113 pages, Bremen, 2001.

No. 179 **Spieß, V. and cruise participants**
Report and preliminary results of R/V Sonne Cruise SO 149, Victoria - Victoria, 16.8. - 16.9.2000. 100 pages, Bremen, 2001.

No. 180 **Kim, J.-H.**
Reconstruction of past sea-surface temperatures in the eastern South Atlantic and the eastern South Pacific across Termination I based on the Alkenone Method. 114 pages, Bremen, 2001.

No. 181 **von Lom-Keil, H.**
Sedimentary waves on the Namibian continental margin and in the Argentine Basin – Bottom flow reconstructions based on high resolution echosounder data. 126 pages, Bremen, 2001.

No. 182 **Hebbeln, D. and cruise participants**
PUCK: Report and preliminary results of R/V Sonne Cruise SO 156, Valparaiso (Chile) - Talcahuano (Chile), March 29 - May 14, 2001. 195 pages, Bremen, 2001.

No. 183 **Wendler, J.**
Reconstruction of astronomically-forced cyclic and abrupt paleoecological changes in the Upper Cretaceous Boreal Realm based on calcareous dinoflagellate cysts. 149 pages, Bremen, 2001.

No. 184 **Volbers, A.**
Planktic foraminifera as paleoceanographic indicators: production, preservation, and reconstruction of upwelling intensity. Implications from late Quaternary South Atlantic sediments. 122 pages, Bremen, 2001.

No. 185 **Bleil, U. and cruise participants**
Report and preliminary results of R/V METEOR Cruise M 49/3, Montevideo (Uruguay) - Salvador (Brasil), March 9 - April 1, 2001. 99 pages, Bremen, 2001.

No. 186 **Scheibner, C.**
Architecture of a carbonate platform-to-basin transition on a structural high (Campanian-early Eocene, Eastern Desert, Egypt) – classical and modelling approaches combined. 173 pages, Bremen, 2001.

No. 187 **Schneider, S.**
Quartäre Schwankungen in Strömungsintensität und Produktivität als Abbild der Wassermassen-Variabilität im äquatorialen Atlantik (ODP Sites 959 und 663): Ergebnisse aus Siltkorn-Analysen. 134 pages, Bremen, 2001.

No. 188 **Uliana, E.**
Late Quaternary biogenic opal sedimentation in diatom assemblages in Kongo Fan sediments. 96 pages, Bremen, 2002.

No. 189 **Esper, O.**
Reconstruction of Recent and Late Quaternary oceanographic conditions in the eastern South Atlantic Ocean based on calcareous- and organic-walled dinoflagellate cysts. 130 pages, Bremen, 2001.

No. 190 **Wendler, I.**
Production and preservation of calcareous dinoflagellate cysts in the modern Arabian Sea. 117 pages, Bremen, 2002.

No. 191 **Bauer, J.**
Late Cenomanian – Santonian carbonate platform evolution of Sinai (Egypt): stratigraphy, facies, and sequence architecture. 178 pages, Bremen, 2002.

No. 192 **Hildebrand-Habel, T.**
Die Entwicklung kalkiger Dinoflagellaten im Südatlantik seit der höheren Oberkreide. 152 pages, Bremen, 2002.

No. 193 **Hecht, H.**
Sauerstoff-Optopoden zur Quantifizierung von Pyritverwitterungsprozessen im Labor- und Langzeit-in-situ-Einsatz. Entwicklung - Anwendung – Modellierung. 130 pages, Bremen, 2002.

No. 194 **Fischer, G. and cruise participants**
Report and Preliminary Results of RV METEOR-Cruise M49/4, Salvador da Bahia – Halifax, 4.4.-5.5.2001. 84 pages, Bremen, 2002.

No. 195 **Gröger, M.**
Deep-water circulation in the western equatorial Atlantic: inferences from carbonate preservation studies and silt grain-size analysis. 95 pages, Bremen, 2002.

No. 196 **Meinecke,G. and cruise participants**
Report of RV POSEIDON Cruise POS 271, Las Palmas - Las Palmas, 19.3.-29.3.2001. 19 pages, Bremen, 2002.

No. 197 **Meggers, H. and cruise participants**
Report of RV POSEIDON Cruise POS 272, Las Palmas - Las Palmas, 1.4.-14.4.2001. 19 pages, Bremen, 2002.

No. 198 **Gräfe, K.-U.**
Stratigraphische Korrelation und Steuerungsfaktoren Sedimentärer Zyklen in ausgewählten Borealen und Tethyalen Becken des Cenoman/Turon (Oberkreide) Europas und Nordwestafrikas. 197 pages, Bremen, 2002.

No. 199 **Jahn, B.**
Mid to Late Pleistocene Variations of Marine Productivity in and Terrigenous Input to the Southeast Atlantic. 97 pages, Bremen, 2002.

No. 200 **Al-Rousan, S.**
Ocean and climate history recorded in stable isotopes of coral and foraminifers from the northern Gulf of Aqaba. 116 pages, Bremen, 2002.

No. 201 **Azouzi, B.**
Regionalisierung hydraulischer und hydrogeochemischer Daten mit geostatistischen Methoden. 108 pages, Bremen, 2002.

No. 202 **Spieß, V. and cruise participants**
Report and preliminary results of METEOR Cruise M 47/3, Libreville (Gabun) - Walvis Bay (Namibia), 01.06 - 03.07.2000. 70 pages, Bremen 2002.

No. 203 **Spieß, V. and cruise participants**
Report and preliminary results of METEOR Cruise M 49/2, Montevideo (Uruguay) - Montevideo, 13.02 - 07.03.2001. 84 pages, Bremen 2002.

No. 204 **Mollenhauer, G.**
Organic carbon accumulation in the South Atlantic Ocean: Sedimentary processes and glacial/interglacial Budgets. 139 pages, Bremen 2002.

No. 205 **Spieß, V. and cruise participants**
Report and preliminary results of METEOR Cruise M49/1, Cape Town (South Africa) - Montevideo (Uruguay), 04.01.2001 - 10.02.2001. 57 pages, Bremen, 2003.

No. 206 **Meier, K.J.S.**
Calcareous dinoflagellates from the Mediterranean Sea: taxonomy, ecology and palaeoenvironmental application. 126 pages, Bremen, 2003.

No. 207 **Rakic, S.**
Untersuchungen zur Polymorphie und Kristallchemie von Silikaten der Zusammensetzung Me2Si2O5 (Me:Na, K). 139 pages, Bremen, 2003.

No. 208 **Pfeifer, K.**
Auswirkungen frühdiagenetischer Prozesse auf Calcit- und Barytgehalte in marinen Oberflächen-sedimenten. 110 pages, Bremen, 2003.

No. 209 **Heuer, V.**
Spurenelemente in Sedimenten des Südatlantik. Primärer Eintrag und frühdiagenetische Überprägung. 136 pages, Bremen, 2003.

No. 210 **Streng, M.**
Phylogenetic Aspects and Taxonomy of Calcareous Dinoflagellates. 157 pages, Bremen 2003.

No. 211 **Boeckel, B.**
Present and past coccolith assemblages in the South Atlantic: implications for species ecology, carbonate contribution and palaeoceanographic applicability. 157 pages, Bremen, 2003.

No. 212 **Precht, E.**
Advective interfacial exchange in permeable sediments driven by surface gravity waves and its ecological consequences. 131 pages, Bremen, 2003.

No. 213 **Frenz, M.**
Grain-size composition of Quaternary South Atlantic sediments and its paleoceanographic significance. 123 pages, Bremen, 2003.

No. 214 **Meggers, H. and cruise participants**
Report and preliminary results of METEOR Cruise M 53/1, Limassol - Las Palmas – Mindelo, 30.03.2002 - 03.05.2002. 81 pages, Bremen, 2003.

No. 215 **Schulz, H.D. and cruise participants**
Report and preliminary results of METEOR Cruise M 58/1, Dakar – Las Palmas, 15.04..2003 – 12.05.2003. Bremen, 2003.

No. 216 **Schneider, R. and cruise participants**
Report and preliminary results of METEOR Cruise M 57/1, Cape Town – Walvis Bay, 20.01. – 08.02.2003. 123 pages, Bremen, 2003.

No. 217 **Kallmeyer, J.**
Sulfate reduction in the deep Biosphere. 157 pages, Bremen, 2003.

No. 218 **Røy, H.**
Dynamic Structure and Function of the Diffusive Boundary Layer at the Seafloor. 149 pages, Bremen, 2003.

No. 219 **Pätzold, J., C. Hübscher and cruise participants**
Report and preliminary results of METEOR Cruise M 52/2&3, Istanbul – Limassol – Limassol, 04.02. – 27.03.2002. Bremen, 2003.

No. 220 **Zabel, M. and cruise participants**
Report and preliminary results of METEOR Cruise M 57/2, Walvis Bay – Walvis Bay, 11.02. – 12.03.2003. 136 pages, Bremen 2003.

No. 221 **Salem, M.**
Geophysical investigations of submarine prolongations of alluvial fans on the western side of the Gulf of Aqaba-Red Sea. 100 pages, Bremen, 2003.

No. 222 **Tilch, E.**
Oszillation von Wattflächen und deren fossiles Erhaltungspotential (Spiekerooger Rückseitenwatt, südliche Nordsee). 137 pages, Bremen, 2003.

No. 223 **Frisch, U. and F. Kockel**
Der Bremen-Knoten im Strukturnetz Nordwest-Deutschlands. Stratigraphie, Paläogeographie, Strukturgeologie. 379 pages, Bremen, 2004.

No. 224 **Kolonic, S.**
Mechanisms and biogeochemical implications of Cenomanian/Turonian black shale formation in North Africa: An integrated geochemical, millennial-scale study from the Tarfaya-LaAyoune Basin in SW Morocco. 174 pages, Bremen, 2004. Report online available only.

No. 225 **Panteleit, B.**
Geochemische Prozesse in der Salz- Süßwasser Übergangszone. 106 pages, Bremen, 2004.

No. 226 **Seiter, K.**
Regionalisierung und Quantifizierung benthischer Mineralisationsprozesse. 135 pages, Bremen, 2004.

No. 227 **Bleil, U. and cruise participants**
Report and preliminary results of METEOR Cruise M 58/2, Las Palmas – Las Palmas (Canary Islands, Spain), 15.05. – 08.06.2003. 123 pages, Bremen, 2004.

No. 228 **Kopf, A. and cruise participants**
Report and preliminary results of SONNE Cruise SO175, Miami - Bremerhaven, 12.11 - 30.12.2003. 218 pages, Bremen, 2004.

No. 229 **Fabian, M.**
Near Surface Tilt and Pore Pressure Changes Induced by Pumping in Multi-Layered Poroelastic Half-Spaces. 121 pages, Bremen, 2004.

No. 230 **Segl, M. , and cruise participants**
Report and preliminary results of POSEIDON cruise 304 Galway – Lisbon, 5. – 22. Oct. 2004. 27 pages, Bremen 2004

No. 231 **Meinecke, G. and cruise participants**
Report and preliminary results of POSEIDON Cruise 296, Las Palmas – Las Palmas, 04.04 – 14.04.2003. 42 pages, Bremen 2005.

No. 232 **Meinecke, G. and cruise participants**
Report and preliminary results of POSEIDON Cruise 310, Las Palmas – Las Palmas, 12.04 – 26.04.2004. 49 pages, Bremen 2005.

No. 233 **Meinecke, G. and cruise participants**
Report and preliminary results of METEOR Cruise 58/3, Las Palmas - Ponta Delgada, 11.06 - 24.06.2003. 50 pages, Bremen 2005.

No. 234 **Feseker, T.**
Numerical Studies on Groundwater Flow in Coastal Aquifers. 219 pages. Bremen 2004.

No. 235 **Sahling, H. and cruise participants**
Report and preliminary results of R/V POSEIDON Cruise P317/4, Istanbul-Istanbul , 16 October - 4 November 2004. 92 pages, Bremen 2004.

No. 236 **Meinecke, G. und Fahrtteilnehmer**
Report and preliminary results of POSEIDON Cruise 305, Las Palmas (Spain) - Lisbon (Portugal), October 28th – November 6th, 2004. 43 pages, Bremen 2005.

No. 237 **Ruhland, G. and cruise participants**
Report and preliminary results of POSEIDON Cruise 319, Las Palmas (Spain) - Las Palmas (Spain), December 6th – December 17th, 2004. 50 pages, Bremen 2005.

No. 238 **Chang, T.S.**
Dynamics of fine-grained sediments and stratigraphic evolution of a back-barrier tidal basin of the German Wadden Sea (southern North Sea). 102 pages, Bremen 2005.

No. 239 **Lager, T.**
Predicting the source strength of recycling materials within the scope of a seepage water prognosis by means of standardized laboratory methods. 141 pages, Bremen 2005.

No. 240 **Meinecke, G.**
DOLAN - Operationelle Datenübertragung im Ozean und Laterales Akustisches Netzwerk in der Tiefsee. Abschlußbericht. 42 pages, Bremen 2005.

No. 241 **Guasti, E.**
Early Paleogene environmental turnover in the southern Tethys as recorded by foraminiferal and organic-walled dinoflagellate cysts assemblages. 203 pages, Bremen 2005.

No. 242 **Riedinger, N.**
Preservation and diagenetic overprint of geochemical and geophysical signals in ocean margin sediments related to depositional dynamics. 91 pages, Bremen 2005.

No. 243 Ruhland, G. and cruise participants
Report and preliminary results of POSEIDON cruise 320, Las Palmas (Spain) - Las Palmas (Spain), March 08th - March 18th, 2005. 57 pages, Bremen 2005.

No. 244 Inthorn, M.
Lateral particle transport in nepheloid layers – a key factor for organic matter distribution and quality in the Benguela high-productivity area. 127 pages, Bremen, 2006.

No. 245 Aspetsberger, F.
Benthic carbon turnover in continental slope and deep sea sediments: importance of organic matter quality at different time scales. 136 pages, Bremen, 2006.

No. 246 Hebbeln, D. and cruise participants
Report and preliminary results of RV SONNE Cruise SO-184, PABESIA, Durban (South Africa) – Cilacap (Indonesia) – Darwin (Australia), July 08th - September 13th, 2005. 142 pages, Bremen 2006.

No. 247 Ratmeyer, V. and cruise participants
Report and preliminary results of RV METEOR Cruise M61/3. Development of Carbonate Mounds on the Celtic Continental Margin, Northeast Atlantic. Cork (Ireland) – Ponta Delgada (Portugal), 04.06. – 21.06.2004. 64 pages, Bremen 2006.

No. 248 Wien, K.
Element Stratigraphy and Age Models for Pelagites and Gravity Mass Flow Deposits based on Shipboard XRF Analysis. 100 pages, Bremen 2006.

No. 249 Krastel, S. and cruise participants
Report and preliminary results of RV METEOR Cruise M65/2, Dakar - Las Palmas, 04.07. – 26.07.2005. 185 pages, Bremen 2006.

No. 250 Heil, G.M.N.
Abrupt Climate Shifts in the Western Tropical to Subtropical Atlantic Region during the Last Glacial. 121 pages, Bremen 2006.

No. 251 Ruhland, G. and cruise participants
Report and preliminary results of POSEIDON Cruise 330, Las Palmas – Las Palmas, November 21th – December 03rd, 2005. 48 pages, Bremen 2006.

No. 252 Mulitza , S. and cruise participants
Report and preliminary results of METEOR Cruise M65/1, Dakar – Dakar, 11.06.- 1.07.2005. 149 pages, Bremen 2006.

No. 253 Kopf, A. and cruise participants
Report and preliminary results of POSEIDON Cruise P336, Heraklion - Heraklion, 28.04. – 17.05.2006. 127 pages, Bremen, 2006.

No. 254 Wefer, G. and cruise participants
Report and preliminary results of R/V METEOR Cruise M65/3, Las Palmas - Las Palmas (Spain), July 31st - August 10th, 2005. 24 pages, Bremen 2006.

No. 255 Hanebuth, T.J.J. and cruise participants
Report and first results of the POSEIDON Cruise P342 GALIOMAR, Vigo – Lisboa (Portugal), August 19th – September 06th, 2006. Distribution Pattern, Residence Times and Export of Sediments on the Pleistocene/Holocene Galician Shelf (NW Iberian Peninsula). 203 pages, Bremen, 2007.

No. 256 Ahke, A.
Composition of molecular organic matter pools, pigments and proteins, in Benguela upwelling and Arctic Sediments. 192 pages, Bremen 2007.

No. 257 Becker, V.
Seeper - Ein Modell für die Praxis der Sickerwasserprognose. 170 pages, Bremen 2007.

No. 258 Ruhland, G. and cruise participants
Report and preliminary results of Poseidon cruise 333, Las Palmas (Spain) – Las Palmas (Spain), March 1st – March 10th, 2006. 32 pages, Bremen 2007.

No. 259 Fischer, G., G. Ruhland and cruise participants
Report and preliminary results of Poseidon cruise 344, leg 1 and leg 2, Las Palmas (Spain) – Las Palmas (Spain),
Oct. 20th –Nov 2nd & Nov. 4th – Nov 13th, 2006. 46 pages, Bremen 2007.

No. 260 Westphal, H. and cruise participants
Report and preliminary results of Poseidon cruise 346, MACUMA. Las Palmas (Spain) – Las Palmas (Spain), 28.12.2006 – 15.1.2007. 49 pages, Bremen 2007.

No. 261 Bohrmann, G., T. Pape, and cruise participants
Report and preliminary results of R/V METEOR Cruise M72/3, Istanbul – Trabzon – Istanbul, March 17th – April 23rd, 2007. Marine gas hydrates of the Eastern Black Sea. 130 pages, Bremen 2007.

No. 262 Bohrmann, G., and cruise participants
Report and preliminary results of R/V METEOR Cruise M70/3, Iraklion – Iraklion, 21 November – 8 December 2006. Cold Seeps of the Anaximander Mountains / Eastern Mediterranean. 75 pages, Bremen 2008.

No. 263 **Bohrmann, G., Spiess, V., and cruise participants**
Report and preliminary results of R/V Meteor Cruise M67/2a and 2b, Balboa -- Tampico -- Bridgetown, 15 March -- 24 April, 2006. Fluid seepage in the Gulf of Mexico. Bremen 2008.

No. 264 **Kopf, A., and cruise participants**
Report and preliminary results of Meteor Cruise M73/1: LIMA-LAMO (Ligurian Margin Landslide Measurements & Observatory), Cadiz, 22.07.2007 – Genoa, 11.08.2007. 170 pages, Bremen 2008.

No. 265 **Hebbeln, D., and cruise participants**
Report and preliminary results of RV Pelagia Cruise 64PE284. Cold-water Corals in the Gulf of Cádiz and on Coral Patch Seamount (NE Atlantic). Portimão - Portimão, 18.02. - 09.03.2008. 90 pages, Bremen 2008.

No. 266 **Bohrmann, G. and cruise participants**
Report and preliminary results of R/V Meteor Cruise M74/3, Fujairah – Male, 30 October - 28 November, 2007. Cold Seeps of the Makran subduction zone (Continental margin of Pakistan). 161 pages, Bremen 2008.

No. 267 **Sachs, O.**
Benthic organic carbon fluxes in the Southern Ocean: Regional differences and links to surface primary production and carbon export. 143 pages, Bremen, 2008.

No. 268 **Zonneveld, K. and cruise participants**
Report and preliminary results of R/V POSEIDON Cruise P339, Piräus - Messina, 16 June - 2 July 2006. CAPPUCCINO - Calabrian and Adriatic palaeoproductivity and climatic variability in the last two millenia. 61 pages, Bremen, 2008.

No. 269 **Ruhland, G. and cruise participants**
Report and preliminary results of R/V POSEIDON Cruise P360, Las Palmas (Spain) - Las Palmas (Spain), Oct. 29th - Nov. 6th, 2007. 27 pages, Bremen, 2008.

No. 270 **Ruhland, G., G. Fischer and cruise participants**
Report and preliminary results of R/V POSEIDON Cruise 365 (Leg 1+2). Leg 1: Las Palmas - Las Palmas, 13.4. - 16.4.2008. Leg 2: Las Palmas - Las Palmas, 18.4. - 29.4.2008. 40 pages, Bremen, 2009.

No. 271 **Kopf, A. and cruise participants**
Report and preliminary results of R/V POSEIDON Cruise P386: NAIL (Nice Airport Landslide), La Seyne sur Mer, 20.06.2009 – La Seyne sur Mer, 06.07.2009. 161 pages, Bremen, 2009.

No. 272 **Freudenthal, T., G. Fischer and cruise participants**
Report and preliminary results of Maria S. Merian Cruise MSM04/4 a & b, Las Palmas (Spain) – Las Palmas (Spain), Feb 27th – Mar 16th & Mar 19th – Apr 1st, 2007. 117 pages, Bremen 2009.

No. 273 **Hebbeln, D., C. Wienberg, L. Beuck, A. Freiwald, P. Wintersteller and cruise participants**
Report and preliminary results of R/V POSEIDON Cruise POS 385 "Cold-Water Corals of the Alboran Sea (western Mediterranean Sea)", Faro - Toulon, May 29 - June 16, 2009. 79 pages, Bremen 2009.

No. 274 **Zonneveld, K. and cruise participants**
Report and preliminary results of R/V Poseidon Cruises P 366-1 and P 366-2, Las Palmas - Las Palmas - Vigo, 03 -19 May 2008 and 22 -30 May 2008. PERGAMOM Proxy Education and Research cruise off Galicai, Morocco and Mauretania. 47 pages, Bremen 2010.

No. 275 **Wienberg, C. and cruise participants**
Report and preliminary results of RV POSEIDON cruise POS400 "CORICON - Cold-water corals along the Irish continental margin", Vigo - Cork, June 29 - July 15 2010. 46 pages, Bremen 2010.

No. 276 **Villinger, H. and cruise participants**
Report and preliminary results of R/V Sonne Cruise SO 207, Caldera-Caldera, 21 June -13 July, 2010. SeamountFlux: Efficient cooling in young oceanic crust caused by circulation of seawater through seamounts (Guatemala Basin, East Pacific Ocean). 161 pages, Bremen 2010.

No. 277 **Fischer, G. and cruise participants**
Report and preliminary results of RV POSEIDON Cruise POS 396, Las Palmas - Las Palmas (Spain), 24 February - 8 March 2010. 22 pages, Bremen 2011.

No. 278 **Bohrmann, G. and cruise participants**
Report and preliminary results of RV MARIA S. MERIAN Cruise MSM 15/2, Istanbul (Turkey) – Piraeus (Greece), 10 May - 2 June 2010. Origin and structure of methane, gas hydrates and fluid flows in the Black Sea. 130 pages, Bremen 2011.

No. 279 **Hebbeln, D. and cruise participants**
Report and preliminary results of RV SONNE Cruise SO-211, Valparaíso - Valparaíso, 2 November – 29 November 2010. ChiMeBo. Bremen 2011.

No. 280 **Bach, W. and cruise participants**
Report and preliminary results of RV SONNE Cruise SO 216, Townsville (Australia) - Makassar (Indonesia), June 14 – July 23, 2011. BAMBUS, Back-Arc Manus Basin Underwater Solfataras. 87 pages, Bremen 2011.

No. 281 **Bohrmann, G. and cruise participants**
Report and preliminary results of RV METEOR Cruise M84/2, Istanbul – Istanbul, 26 February – 02 April, 2011. Origin and Distribution of Methane and Methane Hydrates in the Black Sea. 164 pages, Bremen 2011.

No. 282 **Zonneveld, K. and cruise participants**
Report and preliminary results of R/V POSEIDON Cruise P398, Las Palmas – Lissabon, 1 – 16 April 2010. PAPOCA, Production and preservation of organic carbon in relationship to dust input and nepheloid layers in the upwelling area off NW Africa. 33 pages, Bremen 2011.

No. 283 **Hanebuth, T. J. J. and cruise participants**
Report and preliminary results of RV METEOR Cruise M84/4, GALIOMAR III, Vigo – Vigo, 1st – 28th May, 2011. 139 pages, Bremen 2012.